Special Publication No. 13-02

Survey of Northern Pike in Lakes of Soldotna Creek Drainage, 2002

by

Timothy R. McKinley

February 2013

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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SURVEY OF NORTHERN PIKE IN LAKES OF SOLDOTNA CREEK DRAINAGE, 2002

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February 2013

This investigation was partially financed by the US Fish and Wildlife Service Alaska Coastal Program.

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This document should be cited as:
McKinely, T. R. 2013. Survey of northern pike in lakes of Soldotna Creek drainage, 2002. Alaska Department of Fish and Game, Special Publication No. 13-02, Anchorage.

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ABSTRACT

Northern pike (*Esox lucius*) are not native to the Kenai River drainage. They were initially introduced into the Soldotna Creek drainage and have since been found in other Kenai River tributaries. As part of this project, the eight major lakes (Cisca, Denise, Derks, East Mackey, West Mackey, Sevena, Tree, and Union lakes) of the Soldotna Creek drainage were sampled with gillnets in May and June and again in October of 2002. Of the eight lakes sampled, seven had northern pike, and in five of these lakes, northern pike were the dominant species in gillnet catches. Cisca Lake was the only lake in which no fish of any species, including northern pike, were captured in gillnets. Populations of northern pike in four of these lakes were stunted, averaging 450 mm fork length (FL) or less. Northern pike in these lakes matured at an early age; the proportion of three-year-old fish determined to be adults was 0.80 (SE 0.003). All of the lakes had an intermittent open outlet to Soldotna Creek or another lake except for Denise Lake, which was completely closed. Beaver dams blocked outlets to Soldotna Creek at several lakes and provided an ephemeral natural hindrance to fish movements. Native fish populations in these lakes will likely be impacted. It may be possible to contain, control, or eliminate some or all of these populations through the use of piscicides and intensive gillnetting.

Key words: Kenai River, northern pike, Soldotna Creek, invasive species, Cisca Lake, Denise Lake, Derks Lake, East Mackey Lake, West Mackey Lake, Sevena Lake, Tree Lake, Union Lake, *Esox lucius*

INTRODUCTION

Northern pike (*Esox lucius*) are not native to the Kenai Peninsula. This species was first reported in Derks Lake to the Alaska Department of Fish and Game (ADF&G) in Soldotna in August 1976 (Appendix A1). It was believed that northern pike had been illegally introduced some time before. From this initial introduction, they spread through the remainder of the Soldotna Creek drainage, including East and West Mackey lakes, Soldotna Creek, and Sevena (Soldotna) Lake (Appendix A1). Northern pike have since been found in other lakes and drainages of the Kenai River. The spread of northern pike is thought to have come from both migrations of fish and more illegal introductions. Estimates of northern pike harvest for the Kenai Peninsula in the ADF&G Statewide Harvest Survey have increased in recent years (Table 1), indicating a possible increase in northern pike abundance.

Northern pike have been documented in Soldotna Creek drainage lakes (Figure 1). Soldotna Creek is a small, stained stream that drains a series of lakes northeast of Soldotna, Alaska, on the Kenai Peninsula. It flows approximately seven miles through low wetland areas before entering the Kenai River at approximately river mile 22, roughly one mile upstream of the Sterling Highway Bridge in Soldotna. Historically, adult Chinook salmon (*Oncorhyncus tshawytscha*) and coho salmon (*O. kisutch*), as well as rainbow trout (*O. mykiss*) and Dolly Varden (*Salvelinus malma*), have spawned and reared in parts of the drainage.

Much of the aquatic habitat found in the Kenai River drainage is similar to northern pike habitat found in its native range. The typical course of events when northern pike are introduced into a shallow Alaskan lake without a depth sanctuary for salmonids is as follows: with an abundance of prey, introduced northern pike experience rapid growth and produce an abundance of offspring that survive well; the offspring also experience rapid growth and production; subsequent generations soon consume prey at a rate faster than replacement and after a period of five to 10 years, the northern pike in the lake become stunted in size (254 to 508 mm long), too small for most anglers to pursue (Rutz 1996).

This report focuses on the distribution of northern pike in lakes of the Soldotna Creek drainage, the size of each lake, and access from these lakes to Soldotna Creek itself and the rest of the Kenai River drainage.

Table 1.–Kenai Peninsula northern pike sport harvest estimates, 1981–2002.

Year	Estimated harvest (no. of fish)		
	Lakes	Kenai River	Total
1981	32	ND[a]	32
1982	105	ND[a]	105
1983	294	ND[a]	294
1984	187	ND[a]	187
1985	52	69	121
1986	0	0	0
1987	0	12	12
1988	36	0	36
1989	49	18	67
1990	30	10	40
1991	86	0	86
1992	239	0	239
1993	216	26	242
1994	36	0	36
1995	219	29	248
1996	32	92	124
1997	21	7	28
1998	114	0	114
1999	329	0	329
2000	153	6	159
2001	1,288	0	1,288
2002	368	12	380
Mean			
1981–2002	177	16	189
1998–2002	450	4	454

Source: Alaska Statewide Harvest Surveys (SWHS): Mills (1982-1994); Howe et al. (1995, 1996, 2001a-d); Walker et al. (2003); Jennings et al. (2004, 2006).

Note: "Harvest" = fish kept; "ND" = no data.

[a] No Kenai River northern pike harvest reported by the SWHS prior to 1985 (Mills 1986).

OBJECTIVES

This project had two separate but related objectives:

1) Survey the eight major lakes of the Soldotna Creek drainage for the presence of northern pike.
2) Identify waters in the Soldotna Creek drainage that would allow for efficient removal of northern pike.

Specific tasks performed to address these objectives were as follows:

1) Identify spawning locations in May and June by setting gillnets in likely spawning locations.
2) Identify potential migratory pathways for northern pike among lakes and into Soldotna Creek.
3) Make bathymetric maps of all lakes containing northern pike and estimate surface area and volume of these lakes.

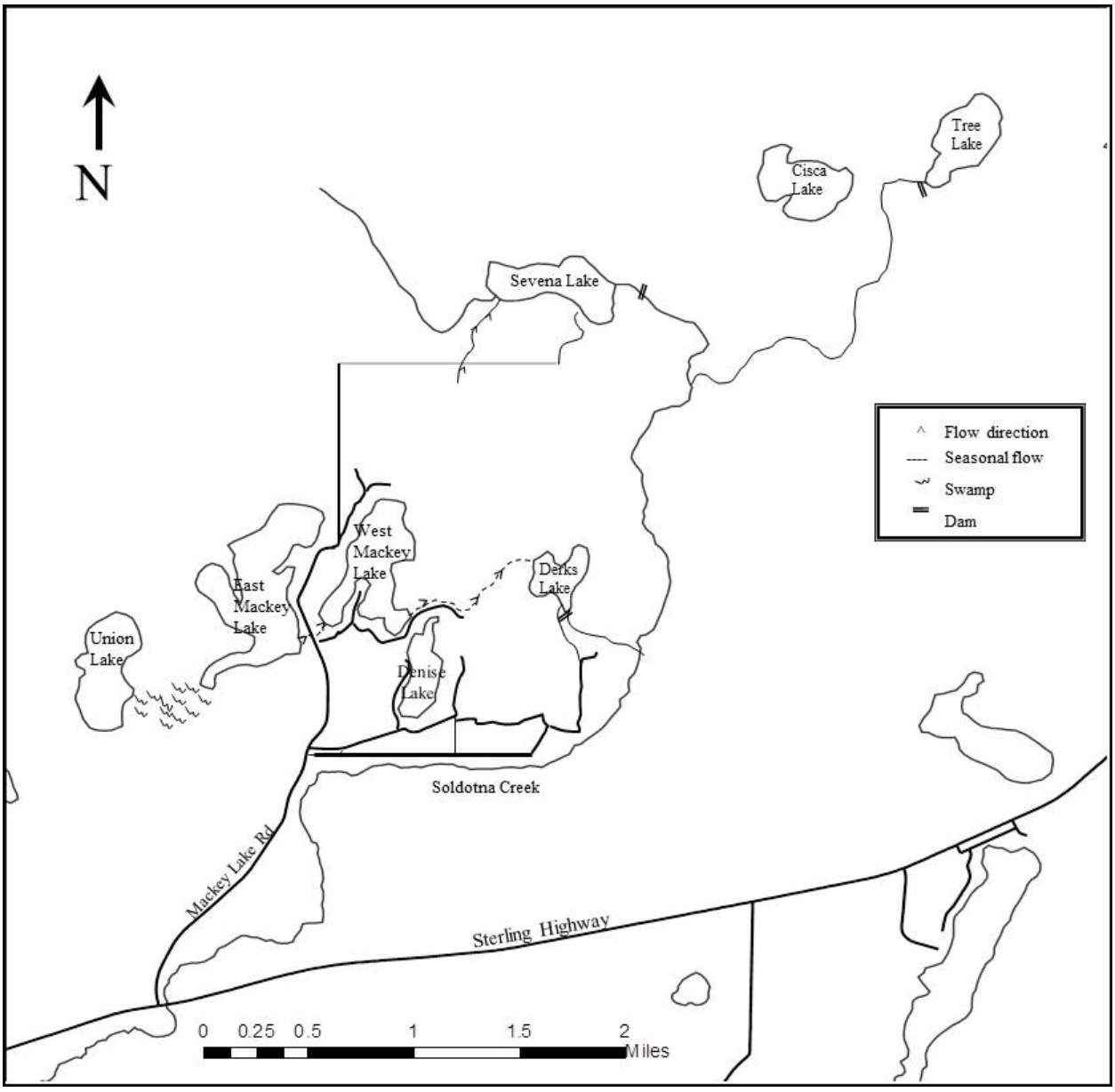

Figure 1.–Lakes of Soldotna Creek drainage.

METHODS

FISH CAPTURE

Lakes in the Soldotna Creek drainage were sampled during May and June, and October 2002. Sampling was primary conducted with overnight sets of variable-size and single-size mesh gillnets, each about 120 ft long and 6 ft deep. Mesh size ranged from 13 to 76 mm stretched length. Studies in Interior Alaska have been unable to demonstrate gear selectivity with northern pike (Roach 1998). In each lake and in each sampling period, a minimum of three and a maximum of six gillnets were fished simultaneously, generally overnight. Additionally, minnow traps baited with cured salmon roe were used to capture and sample fish and fish species smaller than those available for capture in gillnets.

BIOLOGICAL SAMPLING

All captured northern pike were sacrificed and removed from the Soldotna Creek system. Fork length[1] (FL) of captured northern pike was measured to the nearest millimeter. Scale samples were collected from the preferred zone adjacent to but not on the lateral line above the pelvic fin (Williams 1955) on the left side of the fish. Scales were mounted on gummed scale cards for later determination of age. Sex (male or female) and maturity (mature or immature) were determined via visual examination of the gonads. During the May–June sampling period, spawning condition (pre-spawning, spawning, or post-spawning) was recorded, based on whether sex products could be expressed from the gonads. Stomach contents were also recorded for all northern pike captured. All data were recorded on field sampling forms. Northern pike large enough for human consumption were donated to the Kenai Peninsula Food Bank.[2] For fish other than northern pike that were captured in gillnets, the number and fork length (to the nearest millimeter) were recorded and all live fish were released. Species other than northern pike caught in baited minnow traps were counted and recorded before being released alive.

LAKE DEPTH SAMPLING

Depth measurements were taken to the nearest 0.3 meters in each unmapped lake. Measurements were taken with a hand-held portable sonar unit while running transects from a power boat. Depth contour lines were drawn and area and volume of each lake was estimated using the cut-and-weight method (Lind 1979).

WATERSHED CONNECTIVITY

Hydrologic connections (i.e., water flow) between sampled lakes and Soldotna Creek were examined visually during the May–June and October sampling periods. Direction of flow, if discernible, was also recorded.

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[1] Fork length is the distance from the tip of the snout or lower jaw (whichever projects farther) to the tip of the middle rays of the tail fin (Morrow 1980).

[2] Food Bank address: 33955 Community College Dr, Soldotna, AK 99669-9235.

DATA ANALYSIS

Age, Length, Sex, and Maturity Compositions

Mean FL was estimated for northern pike sampled from each lake. Mean FLs were calculated as the arithmetic mean of all fish lengths. Variances were calculated with the squared deviations from the mean (standard variance formula). Standard errors of the mean (SE) were calculated as the square root of the variance divided by the sample size.

The proportion of northern pike of each age, length, sex, or maturity class *k*, in the catch from lake *L*, was calculated as follows:

$$p_{Lk} = \frac{n_{Lk}}{n_L} \quad , \tag{1}$$

where

n_{Lk} = the number of northern pike of age, length, sex, or maturity class *k* from lake *L* and

n_L = the total number of northern pike caught in lake *L*.

The variance of the proportion was estimated as follows:

$$\hat{Var}(p_{Lk}) = \frac{\hat{p}_{Lk}(1-\hat{p}_{Lk})}{n_L - 1} \quad . \tag{2}$$

Catch Per Unit Effort

Catch per unit effort of northern pike was calculated for each lake *L* as follows:

$$C_L = \frac{n_L}{E_L} \quad , \tag{3}$$

where

n_L = the number of northern pike caught in lake *L*, and

E_L = time of operation (effort) of nets in lake *L*.

RESULTS

FISH CAPTURE

Northern pike were found in seven of eight lakes sampled. Gillnet sets in Cisca Lake failed to capture any fish; the only fish species caught in baited minnow traps at Cisca Lake was the threespine stickleback (*Gasterosteus aculeatus*). Cisca Lake was last sampled with gillnets in 1970 and two rainbow trout were the only fish captured (Appendix B1). Cisca Lake was inaccessible in the May–June period and was therefore only sampled in October when it was accessed by floatplane.

A total of 410 northern pike were netted in the remaining seven lakes (Table 2). Based on gillnet catch per unit effort CPUE, northern pike populations were most dense in Derks, East Mackey, Sevena, Union, and West Mackey lakes. In two of the seven lakes, northern pike appeared relatively sparse (Denise and Tree lakes); rainbow trout and land-locked coho salmon were

caught in both of these lakes (Table 3). Species other than northern pike were also caught in gillnet sets in Sevena Lake.

Baited minnow traps set in each lake generally only caught threespine stickleback, if anything, although one juvenile coho salmon was caught in Tree Lake. No fish were caught in baited minnow traps in Derks, East Mackey, Union, and West Mackey lakes (Table 4).

Table 2.–Northern pike gillnet sampling effort and harvest from Soldotna Creek drainage lakes, 2002.

		Gillnet sampling		
			Northern pike	
Sampling period	Location	Effort (hours fished)	Harvest (no. of fish)	CPUE
May–June	Cisca Lake	ND	ND	ND
	Denise Lake	102.0	2	0.02
	Derks Lake	126.0	16	0.13
	E. Mackey Lake	138.0	56	0.41
	Sevena Lake	509.0	109	0.21
	Tree Lake	67.0	4	0.06
	Union Lake	133.5	40	0.30
	W. Mackey Lake	108.0	30	0.28
October	Cisca Lake	132.0	0	0.00
	Denise Lake	130.5	1	0.01
	Derks Lake	137.5	23	0.17
	E. Mackey Lake	125.5	19	0.15
	Sevena Lake	34.5	44	1.28
	Tree Lake	108.0	2	0.02
	Union Lake	123.0	36	0.29
	W. Mackey Lake	134.0	28	0.21
Total		2,108.5	410	0.19

Note: "Harvest" = fish kept; "ND" = no data.

[a] "CPUE" = catch per unit effort.

Table 3.–Bycatch of other fish species from gillnet sampling in Soldotna Creek drainage lakes, 2002.

		Gillnet sampling					
			Bycatch (number of fish)				
			Rainbow trout		Dolly Varden	Coho salmon	
Sampling period	Location	Effort (hours)	Adult	Juvenile	Juvenile	Adult	Juvenile
May–June	Cisca Lake	ND	ND	ND	ND	ND	ND
	Denise Lake	102.0	1				
	Derks Lake	126.0					
	E. Mackey Lake	138.0					
	Sevena Lake	509.0		1	4		4
	Tree Lake	67.0					7
	Union Lake	133.5					
	W. Mackey Lake	108.0					
October	Cisca Lake	132.0					
	Denise Lake	130.5					1
	Derks Lake	137.5					
	E. Mackey Lake	125.5					
	Sevena Lake	34.5		6	1		2
	Tree Lake	108.0		7		7	159
	Union Lake	123.0					
	W. Mackey Lake	134.0					
Total		2,108.5	1	14	5	7	173

Note: "bycatch" = incidental harvest; "ND" = no data.

Table 4.–Fish species presence or absence in minnow trap catches in Soldotna Creek drainage lakes, 2002.

			Minnow trap sampling[a]	
Sampling period	Location	Effort (hours)	Threespine stickleback	Coho salmon juvenile
May–June	Cisca Lake	ND	–	–
	Denise Lake	102.0	X	0
	Derks Lake	126.0	0	0
	E. Mackey Lake	138.0	0	0
	Sevena Lake	509.0	X	0
	Tree Lake	67.0	X	0
	Union Lake	133.5	0	0
	W. Mackey Lake	108.0	0	0
October	Cisca Lake	132.0	X	0
	Denise Lake	130.5	X	0
	Derks Lake	137.5	0	0
	E. Mackey Lake	125.5	0	0
	Sevena Lake	34.5	X	0
	Tree Lake	108.0	X	X
	Union Lake	123.0	0	0
	W. Mackey Lake	134.0	0	0

Note: "ND" = no data; "–" = value can't be computed due to limitations of the data.

[a] X = species present; 0 = species absent.

BIOLOGICAL SAMPLING

Most northern pike captured in these lakes were small; mean FL ranged from 371 to 570 mm. Only three fish had a FL of 800 mm or longer and 18 fish had a FL of 700 mm or longer. Average FL was greatest in Denise, Sevena, and Tree lakes, although the largest fish was captured in Derks Lake (Table 5).

Table 5.–Fork length of northern pike harvested in gillnets from Soldotna Creek drainage lakes, 2002.

Season	Location[a]	Sample size (no. of fish)	Fork length (mm)			
			Minimum	Maximum	Mean	SE
May–June	Denise Lake	2	605	770	688	58
	Derks Lake	16	312	826	425	8
	E. Mackey Lake	56	163	760	421	2
	Sevena Lake	109	225	745	513	1
	Tree Lake	4	727	821	781	10
	Union Lake	40	207	597	411	2
	W. Mackey Lake	30	183	748	371	4
October	Denise Lake	1	500	500	500	-
	Derks Lake	23	128	592	406	4
	E. Mackey Lake	19	160	675	429	7
	Sevena Lake	44	202	778	570	3
	Tree Lake	2	790	810	800	7
	Union Lake	36	165	635	449	3
	W. Mackey Lake	28	170	695	403	5

[a] No northern pike were captured in Cisca Lake.

Age was determined for 391 of the 410 northern pike sampled. The oldest fish were aged 12 years, and most fish in all lakes were aged as less than eight years. Lakes where more than a few northern pike were captured exhibited a broad range of age classes (Table 6).

Male northern pike were more abundant in gillnet catches than females, by almost two to one (Table 7).

Northern pike spawn in the spring during and following ice-out (Morrow 1980). In the seven lakes netted during May–June 2002, females still in spawning condition were found only in Sevena Lake, which was the first lake sampled. Apparently, in all other lakes spawning had been completed. Only spawning males, post-spawning females, and juveniles were captured, even though the lakes had been ice-free for only a few days (Table 8).

Northern pike matured at an early age in these lakes. The proportion of age-3 fish classified as adults was 0.80 (SE 0.003; Table 9). Most captured northern pike were classified as adults.

Sevena Lake was the only lake where a significant proportion of captured northern pike had fish in their stomachs. In the other lakes, leeches, invertebrates, snails, and clams were the main food items (Appendix B1).

Table 6.–Proportion by age of northern pike harvested in gillnets from Soldotna Creek drainage lakes, 2002.

	Proportion by age[a]											
Location	0	1	2	3	4	5	6	7	8	9	10	12
Denise Lake												
Proportion					0.33			0.33	0.33			
SE					(0.11)			(0.11)	(0.11)			
Derks Lake												
Proportion	0.05	0.03	0.03	0.08	0.38	0.27	0.14	0.03				
SE	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)				
E. Mackey Lake												
Proportion	0.01	0.03	0.06	0.15	0.25	0.10	0.21	0.11	0.01	0.03	0.01	0.03
SE	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Sevena Lake												
Proportion	0.01		0.03	0.11	0.26	0.21	0.19	0.08	0.05	0.04	0.03	
SE	(<0.00)		(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	
Tree Lake												
Proportion							0.17	0.50			0.17	0.17
SE							(0.03)	(0.04)			(0.03)	(0.03)
Union Lake												
Proportion	0.04	0.06	0.16	0.16	0.15	0.22	0.15	0.03	0.01			
SE	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)			
W. Mackey Lake												
Proportion	0.05	0.05	0.16	0.24	0.20	0.09	0.09	0.05	0.02	0.02	0.02	
SE	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	

[a] Age units = years.

Table 7.–Sex of northern pike harvested in gillnets from Soldotna Creek drainage lakes, 2002.

Location	Male	Female	Total	Proportion female	SE
Denise Lake	2	1	3	0.33	0.11
Derks Lake	24	13	37	0.35	0.01
E. Mackey Lake	40	32	72	0.44	<0.00
Sevena Lake	94	58	152	0.38	<0.00
Tree Lake	6	0	6	0.00	–
Union Lake	40	29	69	0.42	<0.00
W. Mackey Lake	40	15	55	0.27	<0.00
Total	246	149	395	0.38	<0.00

Note: "–" = can't compute due to limitations of the data.

Table 8.–Maturity of northern pike harvested in gillnets from Soldotna Creek drainage lakes, May–June 2002.

Location	Juvenile	Adult	Total	Proportion adult	SE
Denise Lake	0	2	2	1.00	–
Derks Lake	0	15	15	1.00	–
E. Mackey Lake	8	48	56	0.86	<0.00
Sevena Lake	17	92	109	0.84	<0.00
Tree Lake	0	4	4	1.00	<0.00
Union Lake	5	33	38	0.87	<0.00
W. Mackey Lake	4	26	30	0.87	<0.00
Total	35	220	255	0.86	<0.00

Note: "–" = can't compute due to limitations of the data.

Table 9.–Maturity at age of northern pike harvested in gillnets from Soldotna Creek drainage lakes, 2002.

	Maturity				
Age	Juvenile	Adult	Total	Proportion adult	SE
0	10	0	10	0.00	<0.00
1	6	3	9	0.33	0.03
2	10	18	28	0.64	0.01
3	11	44	55	0.80	<0.00
4	13	81	94	0.86	<0.00
5	1	67	68	0.99	<0.00
6	0	64	64	1.00	<0.00
7	0	30	30	1.00	<0.00
8	1	11	12	0.92	0.01
9	0	9	9	1.00	<0.00
10	0	7	7	1.00	<0.00
12	0	3	3	1.00	<0.00
Unknown - scale missing	0	2	2	1.00	<0.00
Unknown - scale regenerated	1	16	17	0.94	<0.00
Total	53	355	408		

LAKE DEPTH AND WATERSHED CONNECTIVITY

Water flow between sampled lakes and Soldotna Creek was examined visually during the May–June and October sampling periods. In addition, all of Soldotna Creek was examined visually from fixed-wing aircraft, and all but the lower 0.8 RKM were walked or floated via boat. All of the sampled lakes had an intermittent open outlet to Soldotna Creek or another lake except Denise Lake, which was completely closed. Cisca Lake appeared to be open to Soldotna Creek only during periods of very high water. Beaver dams blocked outlets to Soldotna Creek at Derks, Sevena, and Tree lakes (Figure 1, Table 10).

Bathymetric maps were constructed, and area and lake water volume estimated for all eight of the Soldotna Creek drainage lakes (Figures 2-9).

Table 10.–Northern pike, salmonid, and creek access information from Soldotna Creek drainage lakes, 2002.

	Northern pike	Salmonids		
Location	Present	Present	Source	Open/closed to Soldotna Creek
Cisca Lake	No	No	NA	Possible high water connection to creek
Denise Lake	Yes	Yes	Unknown [a]	No connection
Derks Lake	Yes	No	NA	Open except for beaver dam at outlet
E. Mackey Lake	Yes	No	NA	Open to Derk's Lake
Sevena Lake	Yes	Yes	Likely Soldotna Creek	Open except for beaver dam at outlet
Tree Lake	Yes	Yes	Likely Soldotna Creek	Open except for beaver dam at outlet
Union Lake	Yes	No	Formerly stocked by ADF&G	High water connection to W. Mackey Lake
W. Mackey Lake	Yes	No	NA	Open to E. Mackey Lake

Note: "NA" = not applicable.

[a] Possible illegal stocking.

CISCA LAKE

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Department of Fish and Game
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43961 Kalifonsky Beach Rd, Suite B
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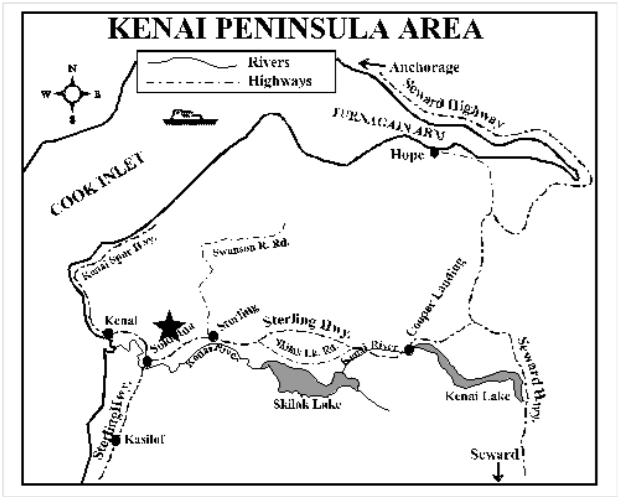
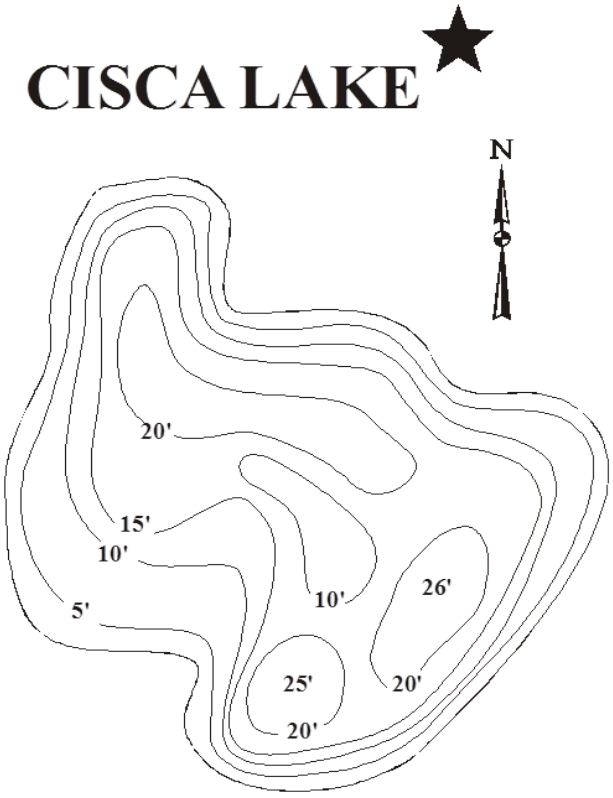
(907) 262-9368



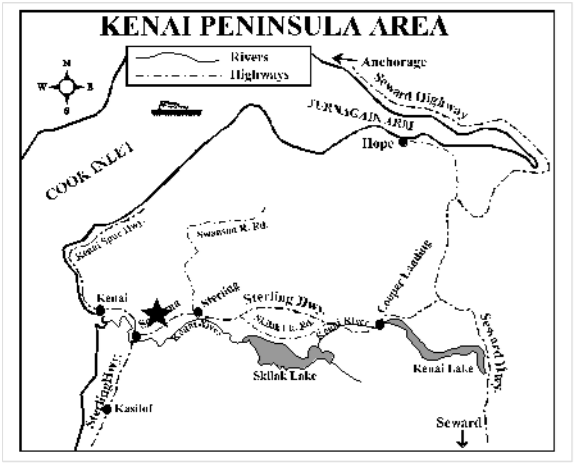


U.S.G.S. Map Ref.	Kenai C-3, T5N, R10W, S6	Geographic Location	150°56'01"W, 60°33'35"N
Elevation	196'	Surface Acres	82
Volume	1,111 Acre Ft.	Maximum Depth	26'
Mean Depth	13.5'	Shoreline Length	1.5 Miles
Game Fish Present			

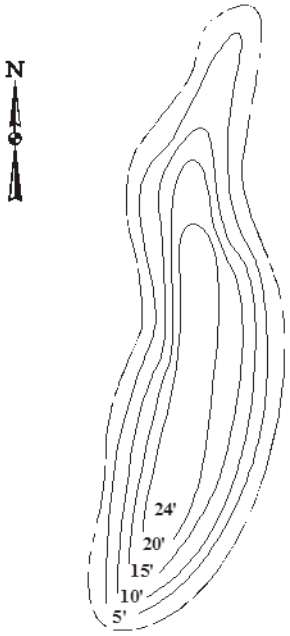
Figure 2.–Bathymetric map of Cisca Lake.

DENISE LAKE

State of Alaska
Department of Fish and Game
Sport Fish Division
43961 Kalifonsky Beach Rd, Suite B
Soldotna, AK 99669-8367
(907) 262-9368



DENISE LAKE



U.S.G.S. Map Ref.	Kenai C-3, T5N, R10W, S14	Geographic Location	150°59'03"W, 60°31'23"N
Elevation	196'	Surface Acres	36
Volume	400 Acre Ft.	Maximum Depth	24'
Mean Depth	11.1'	Shoreline Length	1.2 Miles
Game Fish Present			

Figure 3.–Bathymetric map of Denise Lake.

DERKS LAKE

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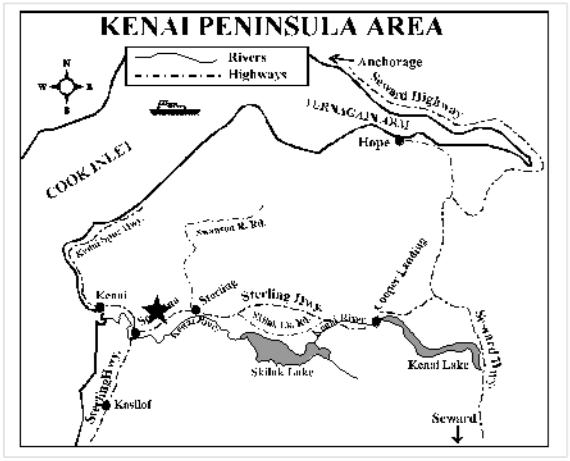
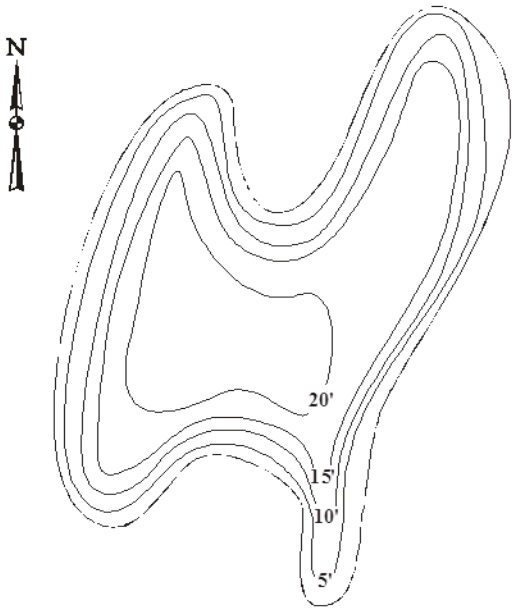


DERKS LAKE



U.S.G.S. Map Ref.	Kenai C-3, T5N, R10W, S12, 13	Geographic Location	150°58'03"W, 60°31'48"N
Elevation	196'	Surface Acres	36
Volume	464 Acre Ft.	Maximum Depth	20'
Mean Depth	12.8'	Shoreline Length	1.2 Miles
Game Fish Present			

Figure 4.–Bathymetric map of Derks Lake.

EAST MACKEY LAKE

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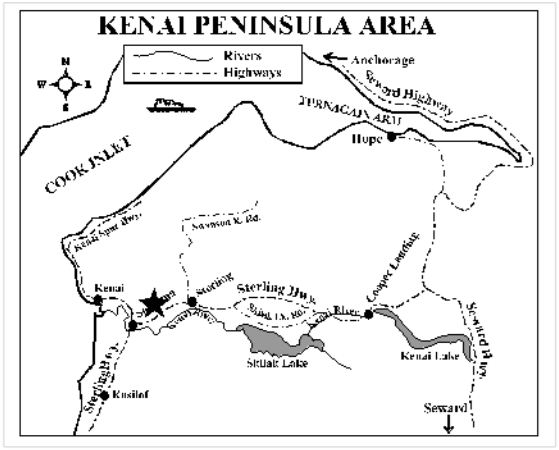
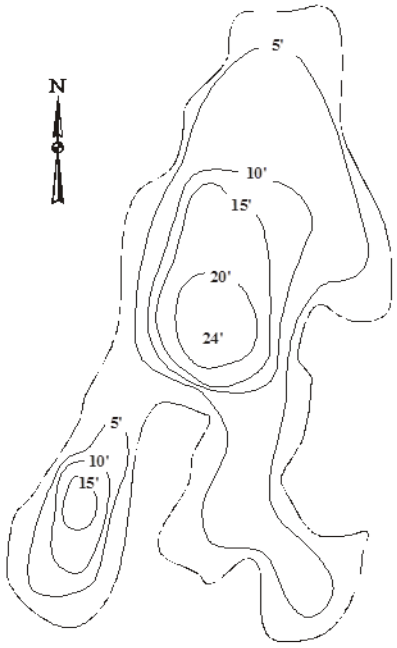


EAST MACKEY LAKE



U.S.G.S. Map Ref.	Kenai C-3, T5N, R10W, S11, 14	Geographic Location	150°59'31"W, 60°31'54"N
Elevation	196'	Surface Acres	94
Volume	787 Acre Ft.	Maximum Depth	24'
Mean Depth	8.4'	Shoreline Length	2.5 Miles
Game Fish Present			

Figure 5.–Bathymetric map of East Mackey Lake.

SEVENA LAKE

State of Alaska
Department of Fish and Game
Sport Fish Division
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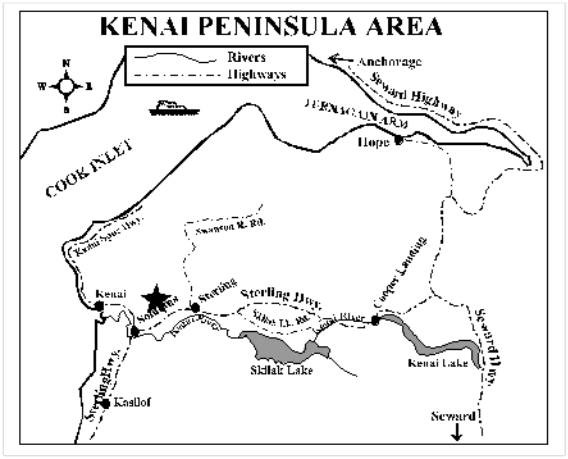
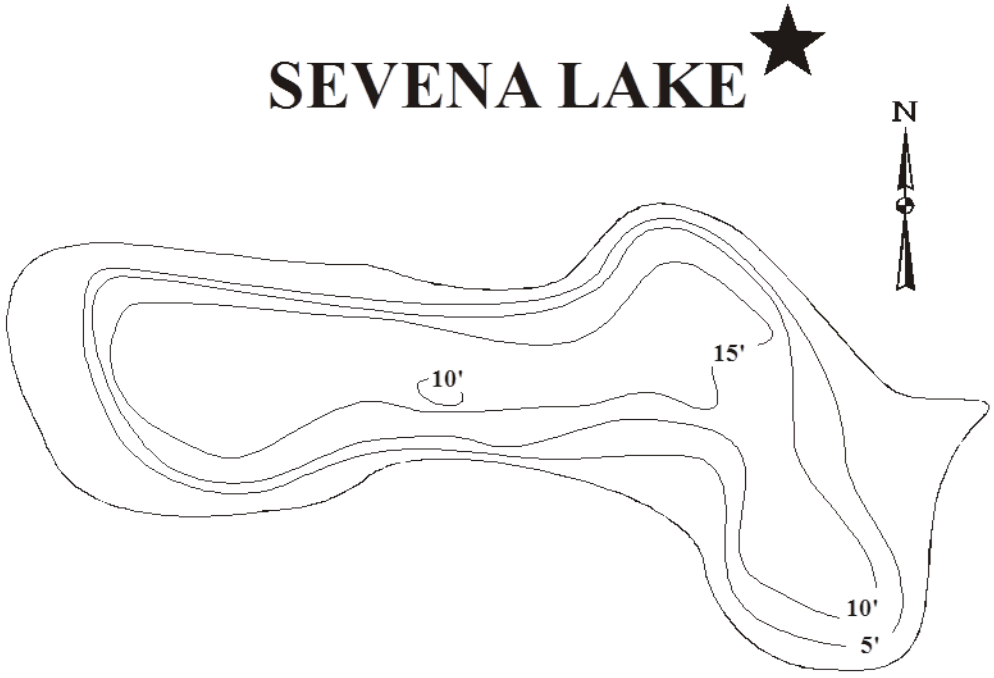
(907) 262-9368





U.S.G.S. Map Ref.	Kenai C-3, TN5, R10W, S 1, 2	Geographic Location	150°58'01"W, 60°33'09"N
Elevation	196'	Surface Acres	65
Volume	595 Acre Ft.	Maximum Depth	15'
Mean Depth	9'	Shoreline Length	1.6 Miles
Game Fish Present			

Figure 6.–Bathymetric map of Sevena Lake.

TREE LAKE

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Department of Fish and Game
Sport Fish Division
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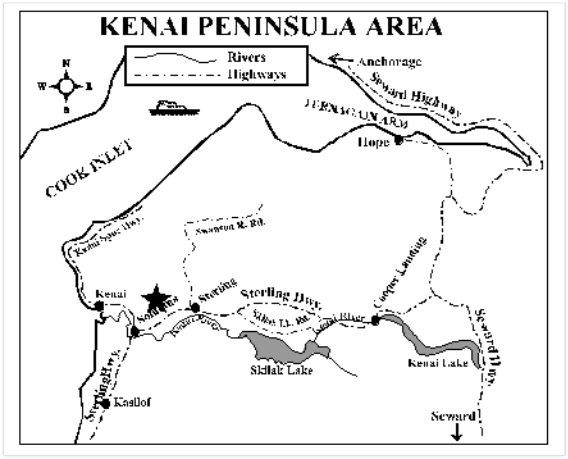
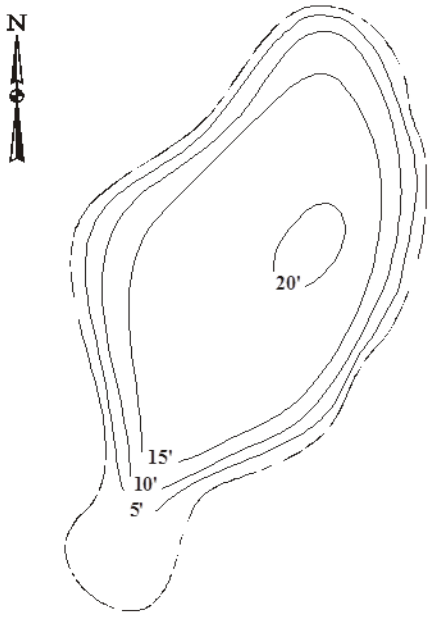
(907) 262-9368



TREE LAKE



U.S.G.S. Map Ref.	Kenai C-3, T6N, R9W, S31, 32	Geographic Location	150°54'37"W, 60°33'48"N
Elevation	219'	Surface Acres	73
Volume	864 Acre Ft.	Maximum Depth	20'
Mean Depth	11.8'	Shoreline Length	1.4 Miles
Game Fish Present			

Figure 7.–Bathymetric map of Tree Lake.

UNION LAKE

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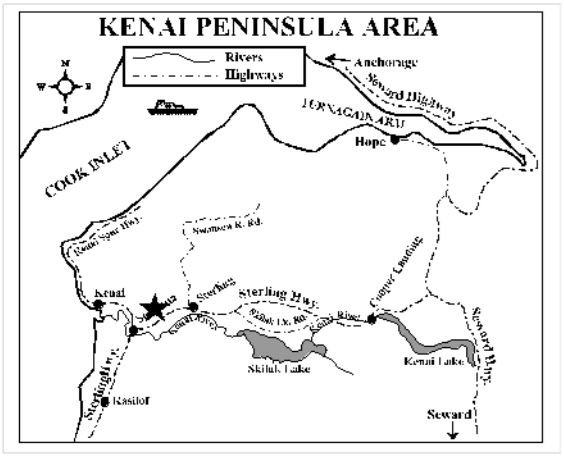

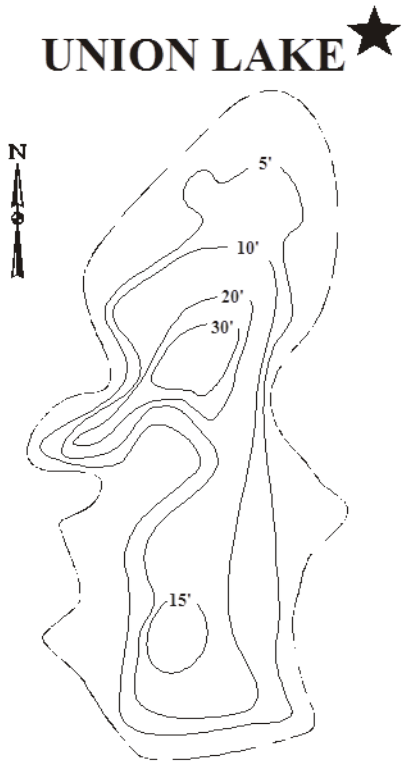

U.S.G.S. Map Ref.	Kenai C-3, T5N, R10W, S15, 16	Geographic Location	151°01'22"W, 60°31'44"N
Elevation	196'	Surface Acres	83
Volume	714 Acre Ft.	Maximum Depth	32'
Mean Depth	8.6'	Shoreline Length	1.5 Miles
Game Fish Present			

Figure 8.–Bathymetric map of Union Lake.

WEST MACKEY LAKE

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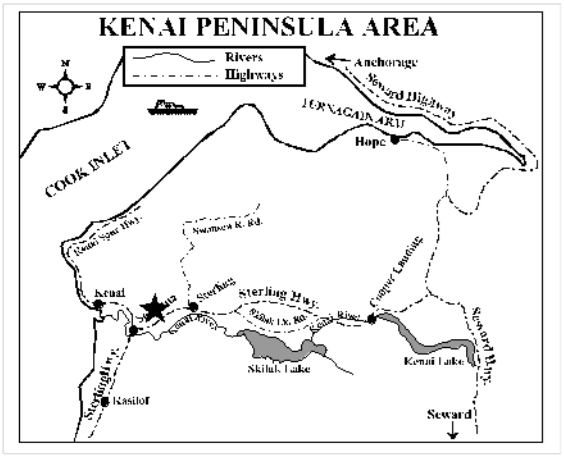
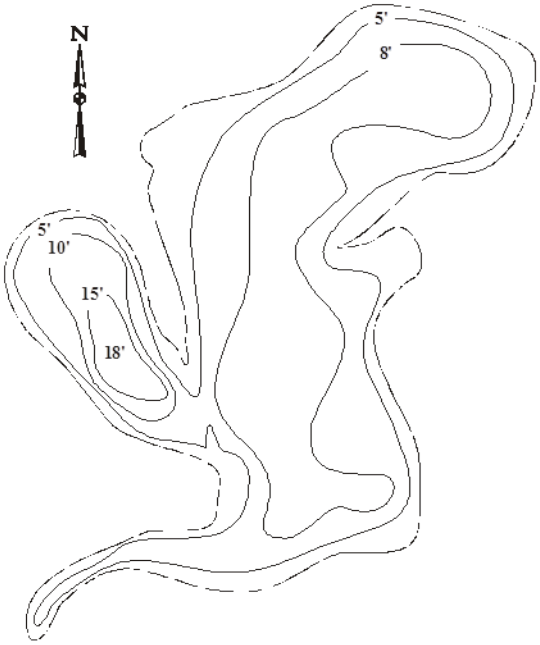


WEST MACKEY LAKE



U.S.G.S. Map Ref.	Kenai C-3, T5N, R10W, S10, 15	Geographic Location	151^{0}00'28"W, 60^{0}31'40"N
Elevation	196'	Surface Acres	161
Volume	1,065 Acre Ft.	Maximum Depth	18'
Mean Depth	6.6'	Shoreline Length	3.9 Miles
Game Fish Present			

Figure 9.–Bathymetric map of West Mackey Lake.

DISCUSSION

This project was the first to delineate and characterize the presence of northern pike in the Soldotna Creek drainage. Northern pike were generally found to be abundant, and native salmonids not, in the major lakes of the Soldotna Creek drainage. Based on anecdotal information from anglers and unpublished data from ADF&G (Appendix A1), some of these lakes previously supported rainbow trout, Dolly Varden, and juvenile coho salmon but now primarily contain northern pike.

Average lengths of northern pike were stunted in all but Denise, Sevena, and Tree lakes and were below what is normally considered an acceptable size for retention by anglers.

Sampling was conducted after spawning was nearly complete so the first task, to find spawning locations, could not be addressed.

During periods with a natural base flow,[3] water passageways between the Soldotna Creek drainage lakes and Soldotna Creek are poor for fish movement. However, improved access during and after flooding events have likely allowed northern pike to spread and proliferate throughout the drainage. Movements of northern pike out of Soldotna Creek drainage lakes are restricted by naturally occurring beaver dams, seasonally low water, and reductions in lake size from historic levels.

Substantive, long-lasting removals of northern pike in this system would be very problematic but worth pursuing. Because of the interconnectedness of these lakes, reductions of northern pike in some lakes could be replaced by individuals from other lakes. To completely eradicate northern pike in these lakes, hydrologic connections would need to be blocked, potentially with rock gabions, during and after the application of piscicides. Northern pike have not been captured in Soldotna Creek, but they probably occur there. However, informal minnow-trapping and visual observations have demonstrated that Dolly Varden, rainbow trout, and juvenile coho salmon are still abundant in Soldotna Creek. Therefore, the application of piscicides to Soldotna Creek to remove northern pike would also kill other fish species.

The potential emigration of northern pike from the Soldotna Creek drainage into the Kenai River and the establishment of northern pike populations in other tributaries is a growing concern. To detect, measure, and stop any movement of northern pike out of the Soldotna Creek drainage into the Kenai River, a weir could be operated in the lower section of Soldotna Creek near its intersection with the Sterling Highway. However, the operation of a weir year-round, for several seasons, would be labor intensive and very costly.

The efficient use of piscicides, such as rotenone, to remove northern pike is problematic because of the urban nature of some of the lakes, the direct flow from lakes into Soldotna Creek and the Kenai River, and the desirable native fish species found in Soldotna Creek. Considering the scope, costs, number of affected individuals, and other pros and cons of a large-scale piscicide project in Soldotna Creek drainage, considerable time and effort should be put into eliciting public opinion on how and where northern pike should be eradicated. Gillnetting in Soldotna Creek lakes should be continued in order to reduce numbers of northern pike and thereby reduce the incidence of emigration into the Kenai River and its tributaries.

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[3] "Base flow" is defined as the sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced streamflows. Natural base flow is sustained largely by ground-water discharge. Source: USGS (United States Geological Survey). 2011. Water science glossary of terms. http://ga.water.usgs.gov/edu/dictionary.html (Accessed March 25, 2011).

ACKNOWLEDGMENTS

I would like to thank the U.S. Fish and Wildlife Service, Alaska Coastal Program for partial funding for this project, in particular Habitat Restoration Branch Chief John DeLapp. I also thank Dr. Dennis R. Lassuy, Regional Invasives Coordinator for the U.S. Fish and Wildlife Service in Anchorage, for his kind support for this invasive species work. A big thanks to the private landowners that assisted us and allowed access to these lakes through their property: Clyde and Roseann Mullican on Sevena Lake, the Freindshuh family on Derks Lake; Dave and April Williams at West Mackey Lake; the Fosse family on West Mackey Lake; Alvin and Earl Pierce on East Mackey Lake; and Tom Shanahan on Union Lake. Their willing assistance and shared knowledge were a great help. Thanks also to my supervisor James Hasbrouck, for biometric and administrative assistance on all aspects of this project. Thanks to Regional Supervisor Barry Stratton for his support and vision to address the spread of northern pike on the Kenai Peninsula. Thanks also to ADF&G employees Patti Berkahn, Adam Reimer, and Jerry Strait for helping with the field aspects of this project. I also thank publications staff members Drew Crawford and Margaret Leonard for their help editing and publishing this report.

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APPENDIX A: REPRODUCED COPY OF UNPUBLISHED ADF&G REPORT (CIRCA 1977) ENTITLED“NORTHERN PIKE (*ESOX LUCIUS* L.) IN THE SOLDOTNA CREEK DRAINGE”

Appendix A1.–Northern pike (*Esox lucius* L.) in the Soldotna Creek system.

This is a reproduction of an *unpublished* ADF&G report (circa 1977) located at ADF&G area office Soldotna, AK, Division of Sport Fish, Research Biologist, *Soldotna Creek drainage* file.

Northern Pike (Esox lucius L.)

in the

Soldotna Creek System

Introduction

Soldotna Creek drains an area of approximately 15 square miles to the immediate east of Soldotna on the Kenai Peninsula. The system is outlined in Figure 1 which shows the highest lake, Tree Lake, at 220 feet above sea level. The creek meandors slowly, and both creek and lakes are bordered by extensive bog and shallow grassy areas which appear to be ideal northern pike habitat (see Figure 2). Until August of 1976, however, it was believed that the Kenai Peninsula was completely free of these fish.

In late August of 1976 the Soldotna office of Fish and Game received a report of northern pike in East Mackey Lake of the Soldotna Creek system. Interviews with local residents indicated that fingerlings may have been illegally introduced to Derk's Lake in 1973 (a claim I will refute later). There are six lakes connected by active tributaries to Soldotna Creek: Derk's, East and West Mackey, Sevena (or Soldotna), Cisca, and Tree. Five of these lakes were fished with gill nets in September of 1976 to establish a minimum distribution of northern pike. In the sixth, Derk's, pike could be seen swimming near shore. Gillnet sampling confirmed the presence of pike in East Mackey Lake and revealed a small population in Sevena Lake. Pike may also be present in the others, as well as Union, South Mackey, Denise, and numerous unnamed lakes which connect with Soldotna Creek during high water. Derk's,

-continued-

This is a reproduction of an unpublished ADF&G report (circa 1977) located at ADF&G area office Soldotna, AK, Division of Sport Fish, Research Biologist, Soldotna Creek drainage file.

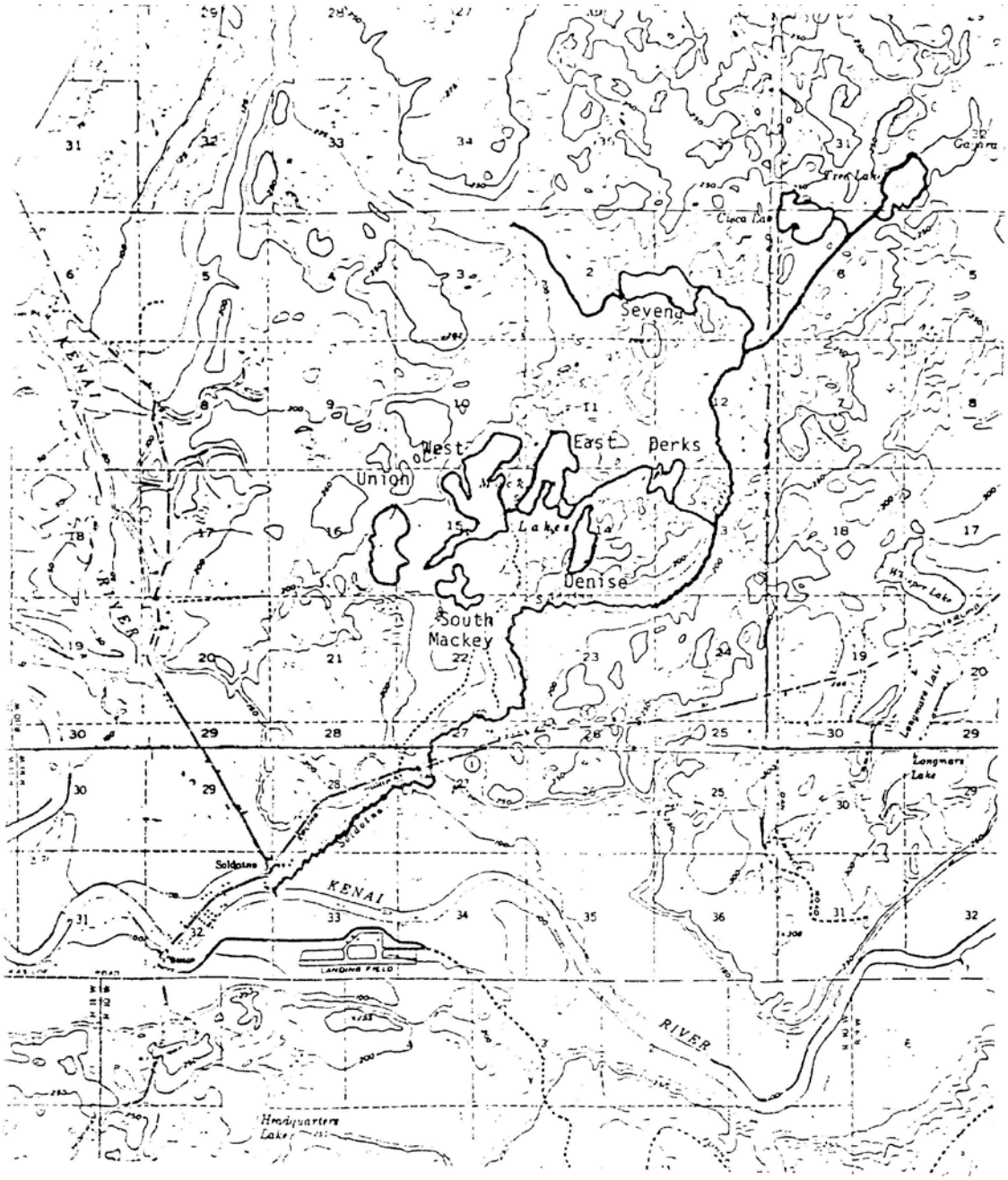

Figure 1: Soldotna Creek System.

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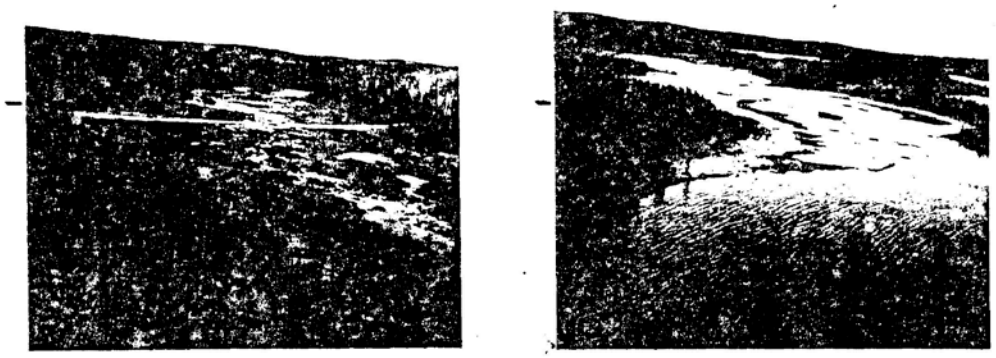

Figure 2: Left, Soldotna Creek near Derk's Lake outlet.
Right, inlet West Mackey Lake.

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Sevena, East Mackey Lake, and West Mackey Lake because of its short connector stream to East Mackey, were all considered "known pike waters" and surveyed with the intention of eradicating northern pike before they could successfully spawn. Plans were made to capture rainbow trout from Sevena Lake, the most productive lake in the system, and transport them to the Fire Lake Hatchery to be artificially spawned the following spring. The resulting fingerlings would be used to restock the four poisoned lakes.

However, local residents objected to the eradication program and requested a public hearing prior to the issuing of a pesticide permit by the Department of Environmental Conservation. The hearing was held and the majority in attendence favored the program, but during the resultant ten day delay rapidly declining temperatures caused considerable surface ice to form and the program was delayed until the spring of 1977. It was believed that the rainbow trout rescue operation and rotenone treatment could not be completed prior to freeze-up.

On March 8, 1977 Fisheries Biologist in Soldotna reviewed the problem and decided against poisoning the Soldotna Creek system after break-up for the following reasons:

1. The complete distribution of northern pike had not been determined.
2. Chemical treatment of spawning shallows in spring run-off conditions is ineffective.
3. Spawning occurs under the ice or immediately after ice-out when lake access is most difficult.

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4. The rapid rise in water temperature, especially in grassy shallows, causes rotenone to breakdown quickly.
5. To treat known pike infested waters at 2.5 ppm would cost $25,700, excluding shipping costs for 33 barrels of rotenone which were not on hand.
6. Capture of sufficient numbers of rainbow trout for spawning and restocking would delay the eradication program further, compounding the problem with water temperature and allowing pike to spawn successfully.
7. Re-establishment of rainbow trout might be difficult in view of the "explosion" of threespine stickleback which has occurred in nearby lakes following similar eradication programs (neamely Bear and Packers Creek Lakes).

It was recommended that attention be given to building one or more control structures, possibly in conjunction with selective rotenone treatments in highly infested areas, to contain the problem until a more permanent solution is found. It was also suggested that fyke nets be used to reduce pike numbers and provide life history information useful in determining further action.

Materials and Methods

The only clear objective at the start of this project on May 17, 1977 was to catch northern pike. The methods of doing this were based on extremely limited local experience with pike and had to be refined as the study progressed.

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Single hoop nets with 30-50 foot leads projecting away from shore were set on May 17 in Derk's, East Mackey, and West Mackey Lakes. The trap in West Mackey was replaced twice in favor of better nets until it was removed on June 28. The trap lead in East Mackey Lake was improvised from a 2" mesh seine and was an effective gill net for northerns until June 17, when the entire trap was removed. Derk's Lake was fished until June 7. A hoop net was set in Sevena Lake from May 27 - June 10. All these traps should have been set with the leads into shore, but the reduced rate of capture allowed me time to learn techniques of fish handling and, especially, aging from experience and references I found later. I also collected data from 10 pike caught by sport fishermen in Derk's Lake.

For small pike (5 - 10 inches) which avoided the above methods I used a 1/4 inch meshed dip net on a six foot handle. I spent several hours in mid June netting small pike in the grassy shallows in the outlet to Derk's Lake. A 1/2 inch mesh gill net was also tried, but with little success.

To get a representative sample of all ages, Steve Hammerstrom directed an electrofishing attempt in Derk's Lake using a D.C. electroshocking generator and riverboat from Sport Fish Division (Hammarstrom, 1975).

On June 1, I anchored two pieces of aluminum conduit on the right side of Soldotna Creek approximately 1/4 mile upstream from the Sterling Highway culvert. A 36 inch wide fyke net was fitted between the conduit from 2100 - 2400 hours that night and from 0900 - 1200 hours the next

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morning as a possible index to pike movement downstream. The conduit was left in the creek so this might be repeated later in the year.

Individual pike were measured to the nearest 1/4 inch from the snout to fork, and disected to determine sex. Scales were collected from every fish midway in its length and just above the lateral line. Otoliths, vertebrae, and opercular bones were removed from several fish as I discovered the different aging techniques, but these were used only to age the fish and support the scale information. Scales were mounted dry between glass slides and read and measured on a Bruining 220 scale reader* at 50X magnification. Anterior radius to the center lobe was measured for each annulus and to the scale edge.

Fish length and natural log (ln) of fish length were regressed on scale radius in order to back-calculate growth. Similar calculations were made with the direct proportion (or Dahl-Lea) method. (Whitney and Carlander, 1956).

Mike Chihuly (graduate student, U.A.F.) instructed me in the technique for projecting light through opercular bones (suspended in xylene) and mounted scales directly onto photographic paper with an enlarger. Vertebrae were photographed with a Hasselblad 500 CM* with a standard 300 lens and 190 mm bellows and an overhead light source.

Results

The first pike were caught mostly from Derk's Lake and I paid special attention to their breeding condition. I found residual eggs

*The brand name is used only as information and is not intended as advertisment.

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in many of the Age III females, but nothing to prove that Age II females had spawned. I found ripe males in both these age classes, however. One local resident reported catching a 26" female (Age III) with ripe eggs on about the 15th of May. My own trapping began on May 17th.

The results of hoop net trapping in Derk's and East Mackey Lakes are shown in Figure 3. In 34 trap days, no pike were caught in West Mackey Lake. Sevena Lake yielded three northerns in 14 trap days. All fish caught were aged by counting scale annuli and comparison with length frequency chart (Figure 3). Many of these were also aged with vertebrae and opercular bones. Figures 4 - 6 clearly show the annuli in scales, vertibrae, and opercular bone. A summary of lengths and scale measurements for all pike caught in this study can be seen in Table 1.

Regressions of both length and ln length on scale radius for Derk's Lake pike are shown in Figures 7 and 8. Back calculations of length based on Dahl-Lea method are summarized on Table 2. Predicted length at annulus formation based on mean annulus size and the two regression methods using all fish are shown with those of the proportion method on Table 3. Whitney and Carlander (1956) discuss the advantages of a proportion method over regression where size range is small and differences in scale formation between size groups is possible. The closer fit of the (ln) regressions among Derk's Lake pike (r^2 of .98 vs. r^2 of .96 in the standard regressions), and the grouping of Age II Derk's Lake pike in comparison with Age II East Mackey pike suggest that scale formation is slightly different between ages and lakes. For these reasons my discussion will be based on the proportion method of back-calculating growth.

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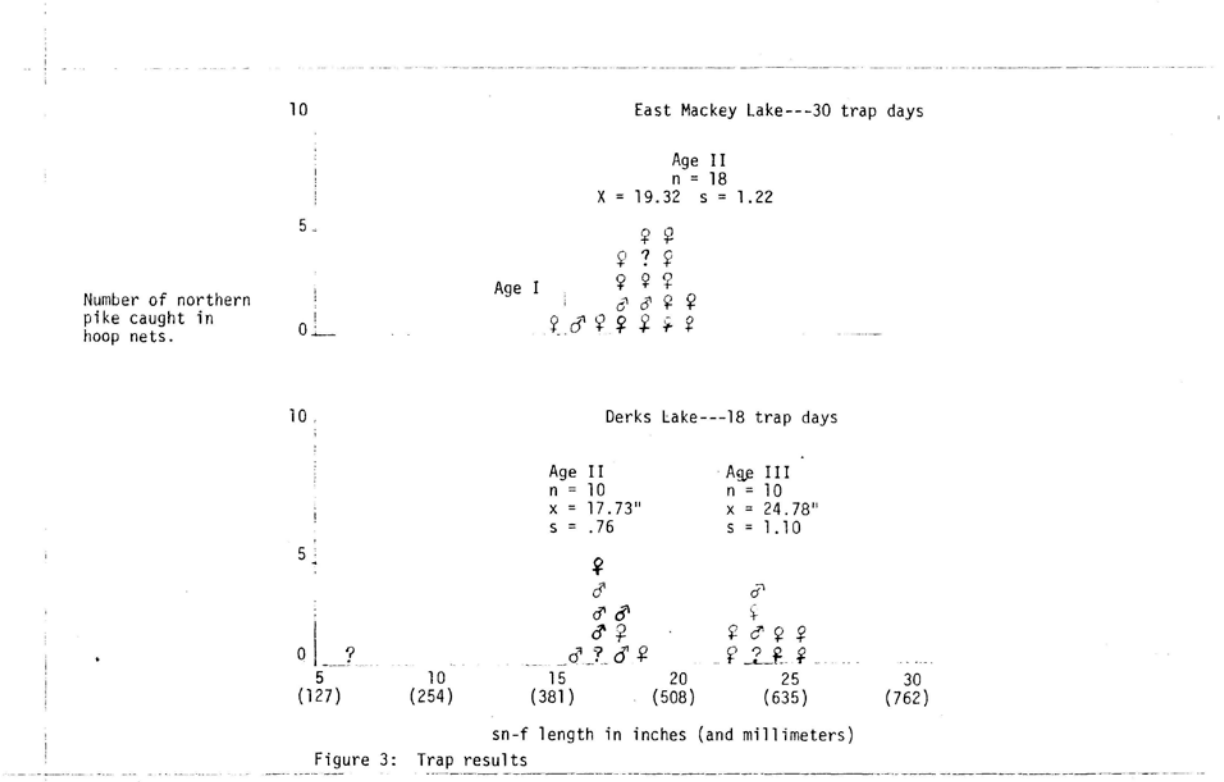

Figure 3: Trap results

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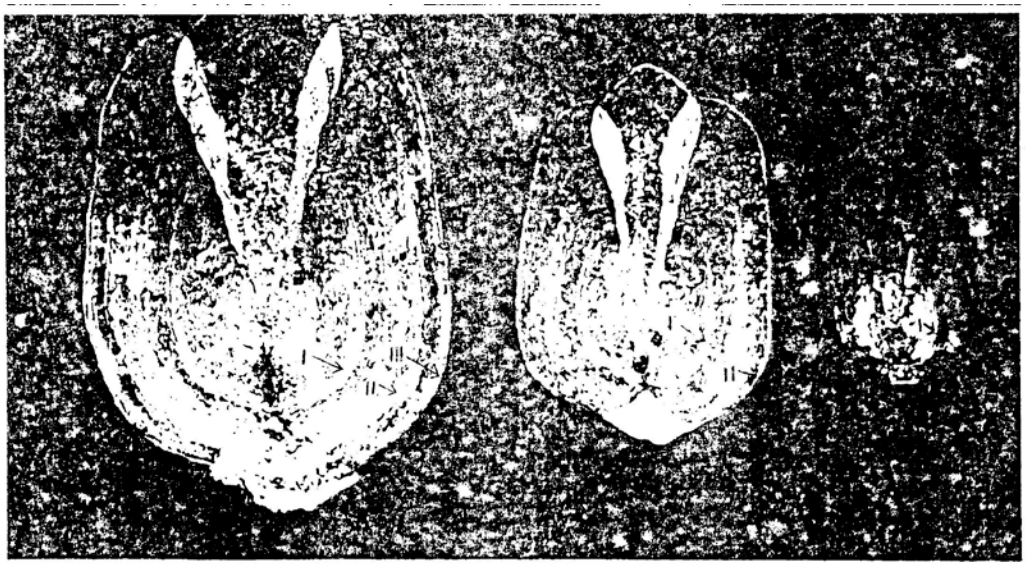

Figure 4: Scales from three pike caught in Derk's Lake measuring 25 1/4", 16 1/2", and 8 3/8". (9.5x)

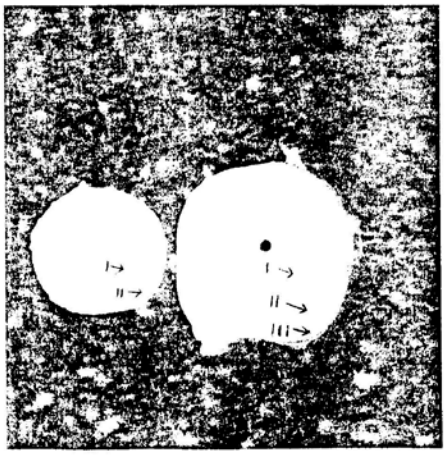

Figure 5: Vertebrae from two pike caught in Derk's Lake measuring 18 1/4" and 24 1/4".

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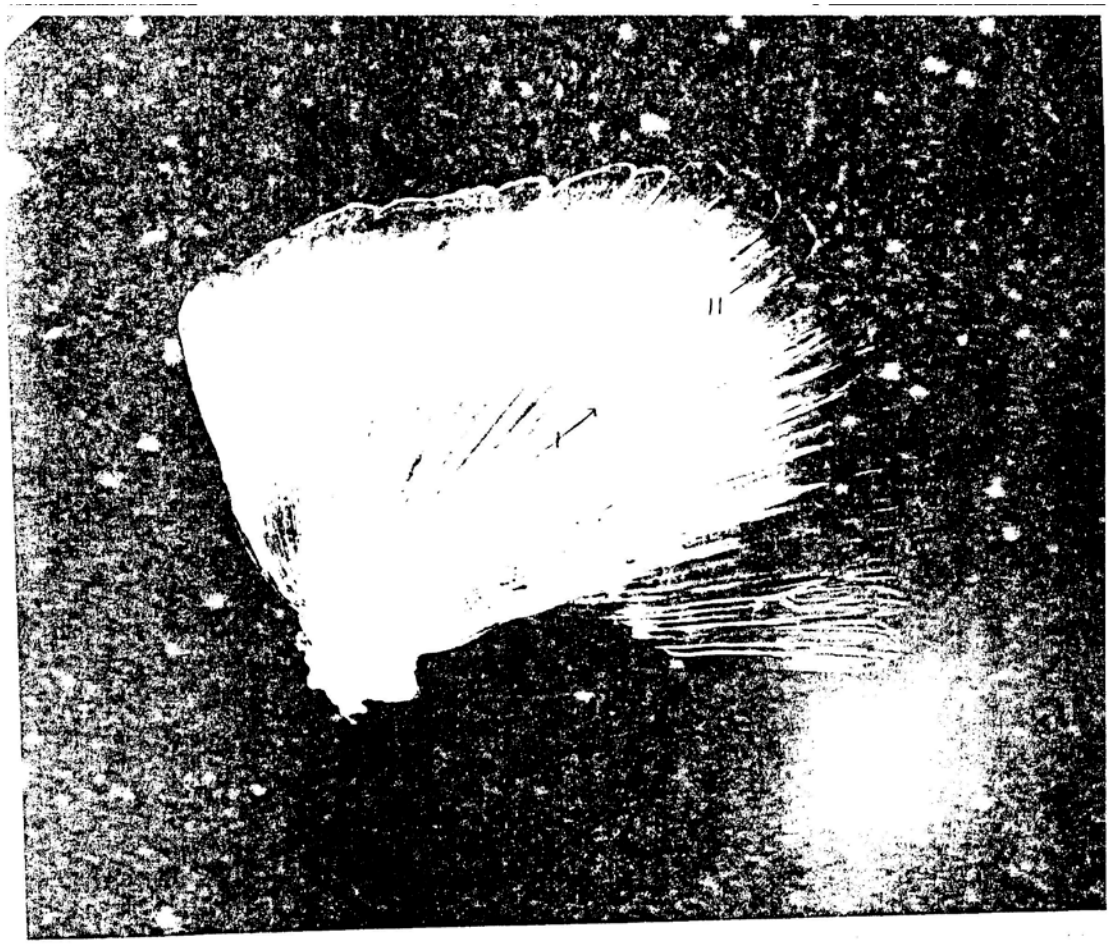

Figure 6: Projected pike opercle from 18 1/2" male caught in Derk's Lake on June 17, 1977. (5x)

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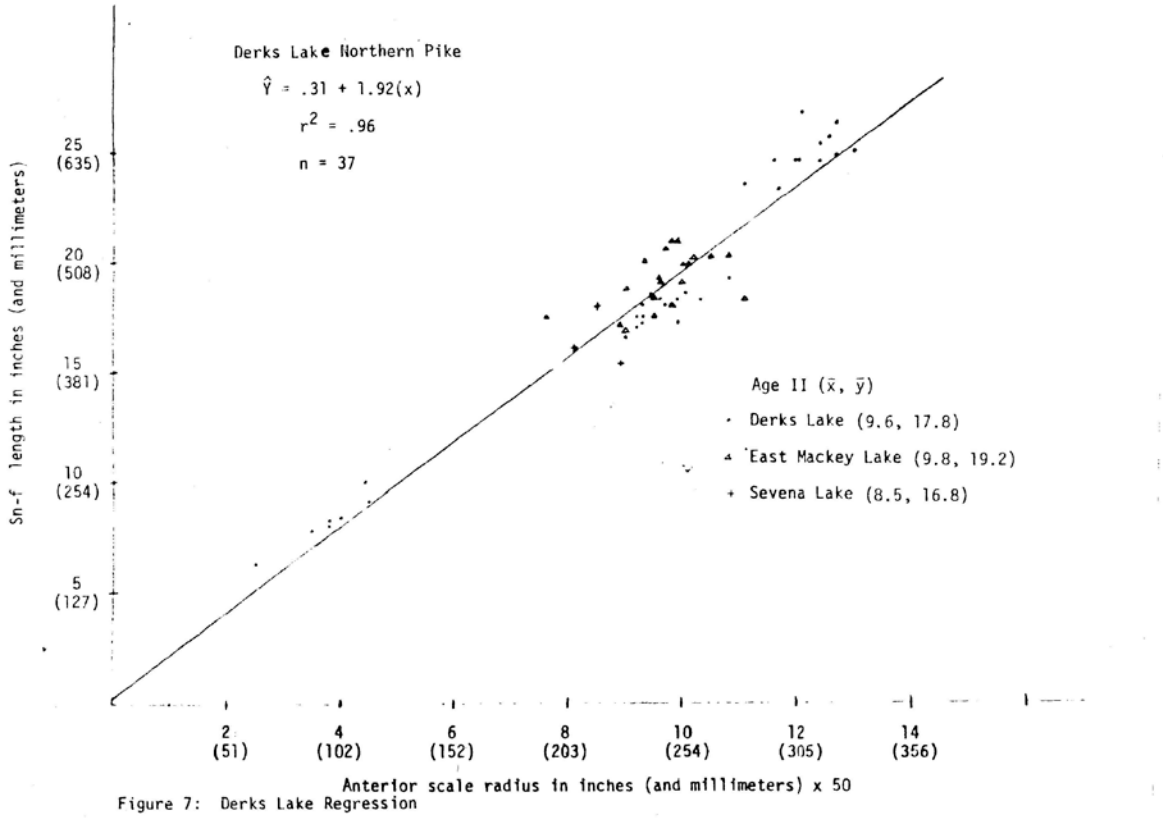

Figure 7: Derks Lake Regression

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This is a reproduction of an *unpublished* ADF&G report (circa 1977) located at ADF&G area office Soldotna, AK, Division of Sport Fish, Research Biologist, *Soldotna Creek drainage* file.

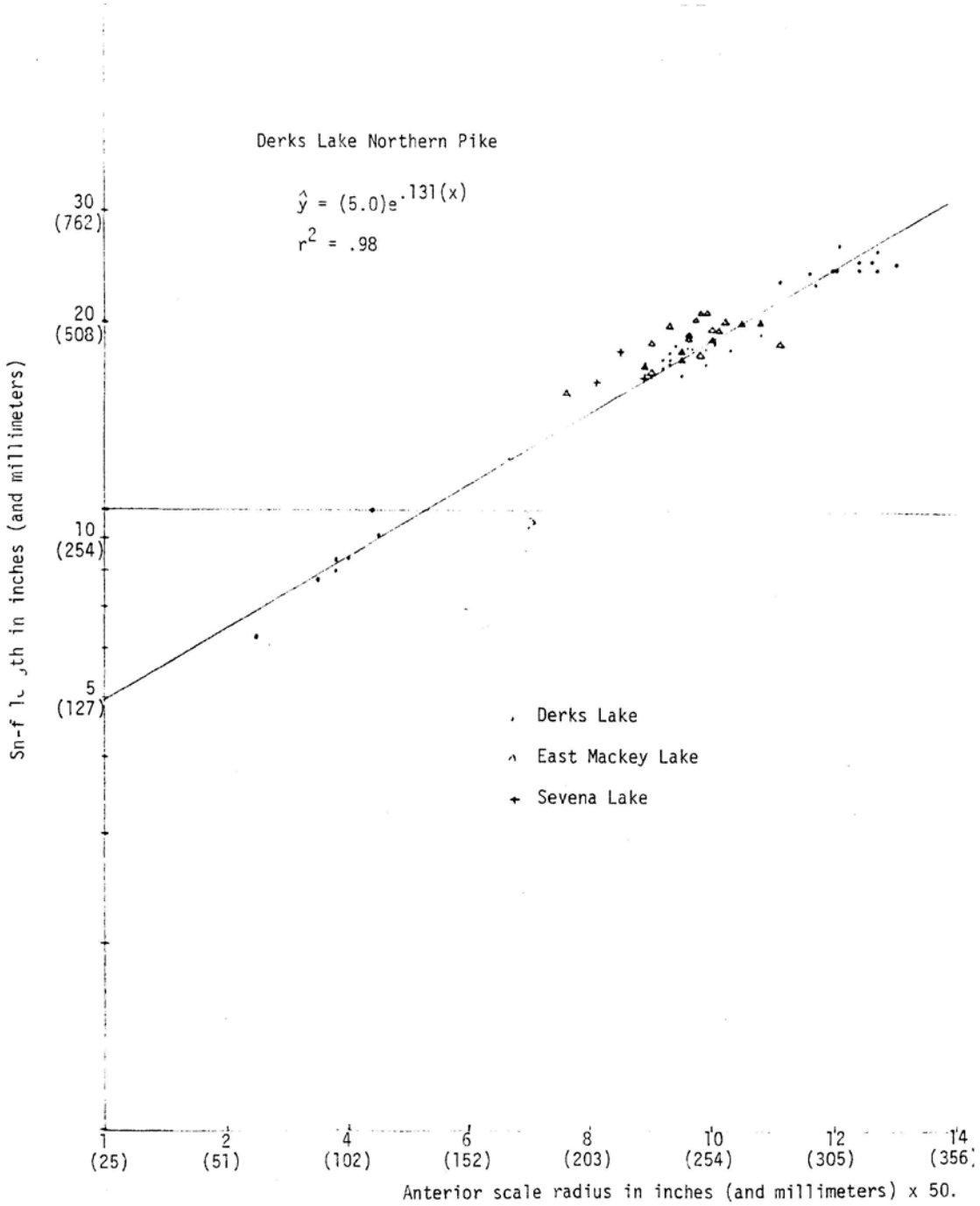

Figure 8: Derks Lake Ln Regression

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		Snout-Fork Length		Anterior Scale Radius (X50)							
				Scale		First Annulus		Second Annulus		Third Annulus	
	n	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Derk's Lake											
Age I	7	8.25(210)	1.17(29.7)	3.79(96)	.67(17.0)	2.77(70)	.47(11.9)				
Age II	18	17.81(452)	.65(16.5)	9.61(244)	.44(11.2)	4.38(111)	.33(8.4)	9.51(242)	.36(9.1)		
Age III	12	24.81(630)	1.00(25.4)	12.19(310)	.55(14.0)	5.99(152)	.50(12.7)	10.3(262)	.55(14.0)	12.12(308)	.48(12.2)
East Mackey Lake											
Age I	1	15.5(394)		7.6(193)		7.5(191)					
Age II	18	19.2(488)	1.35(34.3)	9.82(249)	.60(15.2)	4.66(118)	.62(15.8)	9.67(246)	.53(13.5)		
Sevena Lake											
Age I	0										
Age II	3	16.83(428)	1.04(26.4)	8.50(216)	.40(10.2)	2.73(69.4)	.50(12.8)	8.3(211)	.36(9.2)		

Table 1: Summary of lengths and scale radius measurements in inches (and millimeters).

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		Snout-Fork Length		Predicted Length at Annulus Formation (L_n)					
				First Annulus		Second Annulus		Third Annulus	
	n	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Derk's Lake									
Age I	7	8.25(210)	1.17(29.7)	6.08(154)	1.08(27.4)				
Age II	18	17.81(452)	.65(16.5)	8.11(206)	.64(16.3)	17.59(447)	.65(16.5)		
Age III	12	24.81(630)	1.00(25.4)	12.20(310)	1.02(25.9)	20.96(532)	1.14(29.0)	24.67(627)	1.01(25.7)
East Mackey Lake									
Age I	1	15.5(394)		15.30(389)					
Age II	18	19.2(488)	1.35(34.3)	9.18(233)	1.38(35.1)	19.04(484)	1.28(32.5)		
Sevena Lake									
Age I	0								
Age II	3	16.83(428)	1.04(26.4)	5.44(138)	1.23(31.2)	16.44(418)	1.18(30.0)		

Table 2: Back-calculated lengths in inches (and millimeters) based on Dahl-Lea proportion method: $L_n = \frac{S_n}{S_c} L_c$

L_n = length at annulus n
L_c = length at capture
S_n = anterior scale radius at annulus n
S_c = anterior scale radius at capture

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	Length at First Annulus			Length at Second Annulus			Length at Third Annulus		
	std.*	ln**	Proportion	std.*	ln**	Proportion	std.*	ln**	Proportion
Derks Lake									
Age I	5.82(148)	7.48(190)	6.08(154)						
Age II	8.88(226)	9.22(234)	8.11(206)	18.80(478)	17.90(454)	17.59(447)			
Age III	11.94(303)	11.35(288)	12.20(310)	20.13(511)	19.82(504)	20.96(532)	23.59(599)	25.09(637)	24.66(626)
East Mackey Lake									
Age II	9.41(239)	9.55(242)	9.18(233)	19.18(487)	18.27(464)	19.04(484)			
Sevena Lake									
Age II	5.75(146)	7.44(189)	5.44(138)	16.71(424)	15.30(388)	16.44(418)			

*$\hat{y} = .56 + 1.90x$ $r^2 = .94$ n = 59

**$\hat{y} = (5.23)\, e^{(.13)(x)}$ $r^2 = .96$ n = 59

Table 3: Back-calculated lengths of northern pike based on standard regression, ln regression, and proportion method in inches (and millimeters).

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Northern Pike -7-

On the evening of June 16, 1977 we attempted to collect pike in Derk's Lake by electroshocking. Two hours of shocking during the darkest evening hours failed to produce anything larger than a stickleback. This was probably due to boat avoidance by both pike and rainbow trout, and better results might be obtained in the darker evenings of autumn.

Six hours of index fyke netting in Soldotna Creek produced two Arctic lampreys (Lampetra japonica) and hundreds of stonefly nymphs.

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Discussion

The growth of pike in this system has been exceptional. Back-calculated lengths in the first year ranged from 5.44 - 12.20" (138-310 mm). First year growth in Minto Lakes, Alaska has been reported by Cheney (1971, 1972) as 4.4 and 5.7" (112 and 146 mm) in two successive years. It should be noted that Soldotna Creek pike growth was calculated at annulus formation, while Cheney's measurements were collected in July after some "plus-growth" had occured. Miller and Kennedy (1948) back-calculated growth of pike in four North Canadian lakes using a modified regression technique. Average first year length in Great Bear Lake, Great and Lesser Slave Lakes, and Lake Athabasca were 3.74, 4.17, 5.31, and 3.94", respectively (95, 106, 135, and 100 mm).

By 1976 growth of young fish in Derk's Lake had slowed to a rate comparable to the pike populations mentioned above. Age II pike from East Mackey are slightly larger than Age II Derk's Lake pike at both first and second annulus formation (~~.01~~ significant at $t_{.01}$), but are still comparable and it's likely that pike in both lakes are approaching carrying capacity. Scales from Age II Sevena Lake northerns show much less first year growth (significant at $t = .005$ when compared to Age II Derk's Lake), possibly as a result of a longer migration and marginal habitat from Derk's to Sevena Lake. However, Sevena Lake has an outstanding rainbow trout population (Hammerstrom, pers. comm.) and the few pike caught there show excellent recent growth.

As mentioned earlier and supported by the presence of the oldest pike, Derk's Lake was probably the point of introduction. Growth of

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Age III pike (reflected in scale circuli, show tremendous growth throughout their scaled lifetime, as do Age II pike. It's likely that all pike caught in this program are progeny from spawning which occured here, and that a few mature northerns were present by the spring of 1974, either transplanted as adults the summer before, or as fingerlings still earlier. Average fecundity for a female northern pike is about 32,000 eggs (Scott and Crossman, 1973). It is conceivable that the release of only a few northerns in Derk's Lake could account for the birth of a substantial population in just one or two seasons. More exact information on the transplant could be obtained by capturing some of these parent fish, and that was partly the reason for electroshocking. The age at transplant and subsequent growth would be quite apparent in the scales. Another attempt might be made in Autumn.

The establishment of pike in the Soldotna Creek drainage is probably beyond correction. The shallow, marshy habitat preferred by northerns is practically unreachable with the usual poisoning methods, and the attempt would be expensive (as well as ineffective). Because of the trapping methods I did not analyze stomach contents quantitatively. I did find dragonfly and stonefly nymphs, leeches, sticklebacks, and (of course) rainbow trout in many stomachs that I opened, and in one 26" pike I found a 13 1/2" rainbow trout. Trout fishing is not renowned in any of these lakes, excepting Sevena, and sport fishing for pike may be a change for the better. Sevena Lake, which does have an excellent trout fishery (though access is limited) can probably support tremendous pike predation, and a follow-up study in two or three

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years might be valuable in projecting further effects of the introduction.

Differences in first year growth between lakes indicate that pike are capable of migrating very early, at sizes too small to contain. Given, also, that this was the fourth spawning season (at least) the idea of building a control structure at the mouth of Soldotna Creek was discarded as ineffective. The Kenai River is probably not an insurmountable barrier to pike migration. Further, the possiblity of illegal transplants is now much greater than before. It seems likely that northern pike will eventually turn up in nearby lake systems, and that most of these lakes are ideal for northerns. Several posters have been circulated locally (Figure 9) to enlist the help of local residents in monitoring pike dispersal. The state of pike on the Kenai Peninsula will bear close watch for several years.

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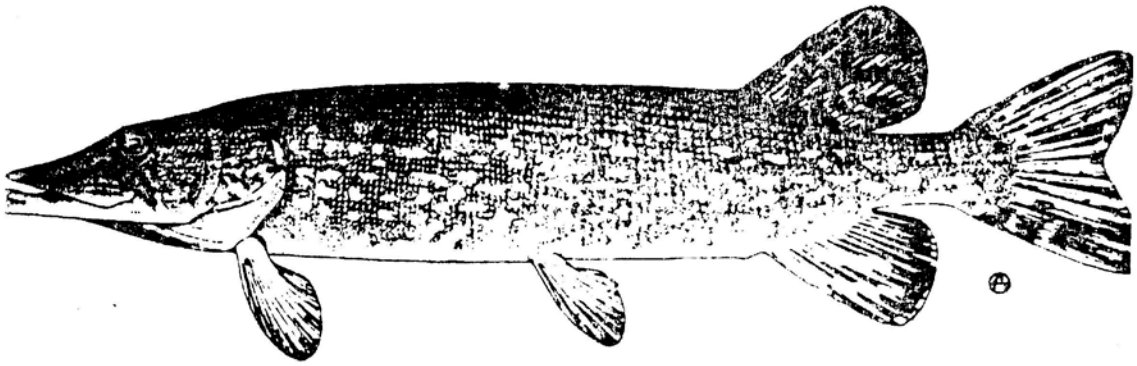
HAVE YOU SEEN or CAUGHT



NORTHERN PIKE

on the

Kenai River or Any of Its Tributaries?

We would appreciate any information on the spread of Northern Pike in this area. Please contact

Fish and Game., FRED Div., Box 1809, Soldotna. Phone 362-4931.

Figure 9

APPENDIX B: CATCH AND BIOLOGICAL SAMPLING DATA FOR NORTHERN PIKE HARVESTED IN SOLDOTNA CREEK DRAINAGE LAKES, 2002.

Appendix B1.–Catch and biological sampling data from northern pike harvested from Soldotna Creek drainage lakes, 2002.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
05/09/2002	spring	Sevena Lake	520	M	5	spawning	empty
05/09/2002	spring	Sevena Lake	520	M	5	spawning	insects
05/09/2002	spring	Sevena Lake	515	M	6	spawning	empty
05/09/2002	spring	Sevena Lake	428	M	4	juvenile	empty
05/13/2002	spring	Sevena Lake	563	M	5	spawning	empty
05/13/2002	spring	Sevena Lake	540	M	5	spawning	empty
05/13/2002	spring	Sevena Lake	523	M	6	spawning	empty
05/13/2002	spring	Sevena Lake	625	F	M	post	empty
05/13/2002	spring	Sevena Lake	620	M	M	spawning	empty
05/13/2002	spring	Sevena Lake	451	M	4	spawning	empty
05/13/2002	spring	Sevena Lake	420	M	4	spawning	empty
05/13/2002	spring	Sevena Lake	570	F	6	post	empty
05/13/2002	spring	Sevena Lake	563	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	521	M	6	spawning	empty
05/13/2002	spring	Sevena Lake	446	M	3	spawning	empty
05/13/2002	spring	Sevena Lake	412	F	4	spawning	empty
05/13/2002	spring	Sevena Lake	612	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	547	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	541	M	6	spawning	empty
05/13/2002	spring	Sevena Lake	408	M	4	spawning	empty
05/13/2002	spring	Sevena Lake	547	F	4	spawning	empty
05/13/2002	spring	Sevena Lake	460	M	4	spawning	empty
05/13/2002	spring	Sevena Lake	422	F	3	juvenile	1 coho salmon (juv)
05/13/2002	spring	Sevena Lake	422	F	4	juvenile	empty
05/13/2002	spring	Sevena Lake	515	M	4	spawning	empty
05/13/2002	spring	Sevena Lake	488	M	5	spawning	empty
05/13/2002	spring	Sevena Lake	271	M	2	juvenile	insects
05/13/2002	spring	Sevena Lake	255	M	2	juvenile	empty
05/13/2002	spring	Sevena Lake	605	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	578	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	510	M	6	spawning	empty
05/13/2002	spring	Sevena Lake	416	M	4	spawning	1 coho salmon (juv)
05/13/2002	spring	Sevena Lake	565	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	515	F	5	spawning	empty
05/13/2002	spring	Sevena Lake	618	F	8	post	1 coho salmon (juv)
05/13/2002	spring	Sevena Lake	225	M	2	juvenile	empty
05/13/2002	spring	Sevena Lake	552	F	6	spawning	empty
05/13/2002	spring	Sevena Lake	545	M	4	spawning	empty
05/13/2002	spring	Sevena Lake	421	M	4	juvenile	empty
05/13/2002	spring	Sevena Lake	681	M	7	spawning	empty
05/13/2002	spring	Sevena Lake	593	M	6	spawning	empty
05/13/2002	spring	Sevena Lake	423	M	4	spawning	insects, sticklebacks
05/15/2002	spring	Sevena Lake	635	F	9	spawning	empty
05/15/2002	spring	Sevena Lake	614	F	6	spawning	empty

-continued-

Appendix B1.–Part 2 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
05/15/2002	spring	Sevena Lake	397	M	3	spawning	empty
05/15/2002	spring	Sevena Lake	437	M	5	spawning	empty
05/15/2002	spring	Sevena Lake	407	M	4	spawning	empty
05/15/2002	spring	Sevena Lake	395	M	3	spawning	insects, sticklebacks
05/15/2002	spring	Sevena Lake	496	M	5	spawning	empty
05/15/2002	spring	Sevena Lake	436	M	5	spawning	sticklebacks
05/15/2002	spring	Sevena Lake	420	M	3	juvenile	empty
05/15/2002	spring	Sevena Lake	562	M	5	spawning	empty
05/15/2002	spring	Sevena Lake	393	M	4	spawning	empty
05/15/2002	spring	Sevena Lake	550	F	6	spawning	1 coho salmon (juv)
05/15/2002	spring	Sevena Lake	543	M	6	spawning	empty
05/15/2002	spring	Sevena Lake	526	F	5	post	empty
05/15/2002	spring	Sevena Lake	452	F	4	juvenile	empty
05/15/2002	spring	Sevena Lake	573	F	5	spawning	empty
05/15/2002	spring	Sevena Lake	550	F	5	spawning	empty
05/15/2002	spring	Sevena Lake	601	M	6	spawning	empty
05/15/2002	spring	Sevena Lake	232	F	2	juvenile	empty
05/15/2002	spring	Sevena Lake	443	F	4	juvenile	sticklebacks
05/15/2002	spring	Sevena Lake	394	F	3	juvenile	1 coho salmon (juv), sculpin
05/15/2002	spring	Sevena Lake	516	M	5	spawning	sticklebacks
05/15/2002	spring	Sevena Lake	415	M	3	spawning	empty
05/16/2002	spring	Sevena Lake	745	F	7	spawning	empty
05/16/2002	spring	Sevena Lake	580	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	542	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	535	M	5	spawning	empty
05/16/2002	spring	Sevena Lake	503	M	5	spawning	leeches, insects
05/16/2002	spring	Sevena Lake	653	M	7	spawning	empty
05/16/2002	spring	Sevena Lake	643	M	9	spawning	empty
05/16/2002	spring	Sevena Lake	620	M	8	spawning	empty
05/16/2002	spring	Sevena Lake	605	F	6	spawning	empty
05/16/2002	spring	Sevena Lake	406	M	4	spawning	empty
05/16/2002	spring	Sevena Lake	660	M	9	spawning	empty
05/16/2002	spring	Sevena Lake	600	M	7	spawning	empty
05/16/2002	spring	Sevena Lake	510	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	436	M	4	spawning	empty
05/16/2002	spring	Sevena Lake	392	M	4	juvenile	leeches
05/16/2002	spring	Sevena Lake	629	M	9	spawning	empty
05/16/2002	spring	Sevena Lake	502	M	5	spawning	empty
05/16/2002	spring	Sevena Lake	412	M	4	spawning	empty
05/16/2002	spring	Sevena Lake	400	M	4	spawning	insects, sticklebacks
05/16/2002	spring	Sevena Lake	407	M	4	juvenile	sticklebacks
05/16/2002	spring	Sevena Lake	680	M	8	spawning	empty
05/16/2002	spring	Sevena Lake	513	M	4	spawning	empty
05/16/2002	spring	Sevena Lake	421	M	4	spawning	sticklebacks
05/16/2002	spring	Sevena Lake	403	M	4	spawning	empty

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Appendix B1.–Part 3 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
05/16/2002	spring	Sevena Lake	702	M	10	spawning	empty
05/16/2002	spring	Sevena Lake	542	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	418	F	4	juvenile	empty
05/16/2002	spring	Sevena Lake	387	M	3	juvenile	leeches, sticklebacks
05/16/2002	spring	Sevena Lake	625	M	7	spawning	empty
05/16/2002	spring	Sevena Lake	605	M	7	spawning	empty
05/16/2002	spring	Sevena Lake	561	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	410	M	4	spawning	empty
05/16/2002	spring	Sevena Lake	714	F	7	spawning	empty
05/16/2002	spring	Sevena Lake	637	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	623	F	7	spawning	empty
05/16/2002	spring	Sevena Lake	545	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	631	M	6	spawning	empty
05/16/2002	spring	Sevena Lake	592	M	7	spawning	empty
05/16/2002	spring	Sevena Lake	421	M	4	spawning	empty
05/16/2002	spring	Sevena Lake	451	F	4	juvenile	leeches, sticklebacks
05/16/2002	spring	Sevena Lake	662	M	7	spawning	empty
05/16/2002	spring	Sevena Lake	633	M	8	spawning	empty
05/16/2002	spring	Sevena Lake	545	F	6	spawning	empty
05/16/2002	spring	Sevena Lake	425	M	4	spawning	sticklebacks
05/17/2002	spring	Stormy Lake	329	F	3	juvenile	empty
05/21/2002	spring	E. Mackey Lake	471	M	6	spawning	insects
05/21/2002	spring	E. Mackey Lake	418	M	6	spawning	insects
05/21/2002	spring	E. Mackey Lake	760	F	12	post	2 northern pike
05/21/2002	spring	E. Mackey Lake	682	F	12	post	leeches
05/21/2002	spring	E. Mackey Lake	506	F	6	post	detritus
05/21/2002	spring	E. Mackey Lake	289	F	3	juvenile	empty
05/21/2002	spring	E. Mackey Lake	385	M	4	spawning	empty
05/21/2002	spring	E. Mackey Lake	379	M	4	spawning	empty
05/21/2002	spring	E. Mackey Lake	312	M	R	spawning	insects
05/21/2002	spring	E. Mackey Lake	503	F	7	post	leeches
05/21/2002	spring	E. Mackey Lake	484	F	6	post	pike
05/21/2002	spring	E. Mackey Lake	470	F	4	post	insects
05/21/2002	spring	E. Mackey Lake	535	M	7	spawning	leeches, insects
05/21/2002	spring	E. Mackey Lake	505	M	6	spawning	insects
05/21/2002	spring	E. Mackey Lake	402	M	5	spawning	insects
05/21/2002	spring	E. Mackey Lake	237	M	2	spawning	insects
05/21/2002	spring	E. Mackey Lake	577	F	8	juvenile	empty
05/21/2002	spring	E. Mackey Lake	370	F	4	juvenile	empty
05/21/2002	spring	E. Mackey Lake	448	M	6	spawning	empty
05/21/2002	spring	E. Mackey Lake	495	F	6	post	insects
05/21/2002	spring	E. Mackey Lake	462	F	5	post	empty
05/21/2002	spring	E. Mackey Lake	462	F	7	post	insects
05/21/2002	spring	E. Mackey Lake	338	F	4	juvenile	insects
05/21/2002	spring	E. Mackey Lake	225	M	2	juvenile	empty

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Appendix B1.–Part 4 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
05/21/2002	spring	E. Mackey Lake	500	M	7	spawning	empty
05/21/2002	spring	E. Mackey Lake	447	M	5	spawning	empty
05/21/2002	spring	E. Mackey Lake	430	M	R	spawning	insects
05/21/2002	spring	E. Mackey Lake	402	M	4	spawning	empty
05/21/2002	spring	E. Mackey Lake	330	M	4	spawning	leeches
05/21/2002	spring	E. Mackey Lake	183	?	1	juvenile	empty
05/21/2002	spring	E. Mackey Lake	508	M	5	spawning	large fish head
05/21/2002	spring	E. Mackey Lake	451	M	7	spawning	empty
05/21/2002	spring	E. Mackey Lake	410	M	4	spawning	leeches, insects
05/21/2002	spring	E. Mackey Lake	374	M	4	spawning	insects
05/21/2002	spring	E. Mackey Lake	293	M	3	juvenile	leeches, insects
05/21/2002	spring	E. Mackey Lake	163	?	1	juvenile	empty
05/21/2002	spring	E. Mackey Lake	512	M	7	spawning	insects
05/21/2002	spring	E. Mackey Lake	341	M	4	spawning	insects
05/21/2002	spring	E. Mackey Lake	304	M	3	spawning	insects
05/21/2002	spring	E. Mackey Lake	508	F	5	post	leeches
05/21/2002	spring	E. Mackey Lake	451	F	6	post	leeches, insects
05/21/2002	spring	E. Mackey Lake	512	M	7	spawning	empty
05/21/2002	spring	E. Mackey Lake	348	M	4	spawning	empty
05/21/2002	spring	E. Mackey Lake	297	M	3	spawning	empty
05/21/2002	spring	E. Mackey Lake	640	F	6	post	leeches, insects, snails
05/21/2002	spring	E. Mackey Lake	500	F	6	post	insects
05/21/2002	spring	E. Mackey Lake	493	M	6	spawning	insects
05/21/2002	spring	E. Mackey Lake	423	M	6	spawning	leeches
05/21/2002	spring	E. Mackey Lake	360	M	4	spawning	empty
05/21/2002	spring	E. Mackey Lake	462	F	6	post	insects
05/21/2002	spring	E. Mackey Lake	361	F	4	post	empty
05/21/2002	spring	E. Mackey Lake	390	M	4	spawning	empty
05/21/2002	spring	E. Mackey Lake	358	M	4	spawning	insects
05/21/2002	spring	E. Mackey Lake	319	M	3	spawning	insects
05/21/2002	spring	E. Mackey Lake	421	F	6	post	insects
05/21/2002	spring	E. Mackey Lake	364	F	R	post	leeches, insects
05/21/2002	spring	W. Mackey Lake	475	M	5	spawning	insects
05/21/2002	spring	W. Mackey Lake	328	M	3	spawning	leeches, insects
05/21/2002	spring	W. Mackey Lake	298	F	3	juvenile	empty
05/21/2002	spring	W. Mackey Lake	365	M	4	spawning	leeches, insects
05/21/2002	spring	W. Mackey Lake	308	M	3	spawning	leeches
05/21/2002	spring	W. Mackey Lake	433	F	4	post	insects
05/21/2002	spring	W. Mackey Lake	748	M	10	spawning	?
05/21/2002	spring	W. Mackey Lake	320	M	3	spawning	insects
05/21/2002	spring	W. Mackey Lake	280	M	3	spawning	insects
05/21/2002	spring	W. Mackey Lake	600	M	8	spawning	empty
05/21/2002	spring	W. Mackey Lake	335	F	3	post	empty
05/21/2002	spring	W. Mackey Lake	210	M	2	juvenile	insects
05/21/2002	spring	W. Mackey Lake	563	M	7	spawning	insects

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Appendix B1.–Part 5 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
05/21/2002	spring	W. Mackey Lake	282	M	3	spawning	insects
05/21/2002	spring	W. Mackey Lake	270	M	2	spawning	empty
05/21/2002	spring	W. Mackey Lake	306	M	3	spawning	leeches, insects
05/21/2002	spring	W. Mackey Lake	228	M	2	spawning	insects
05/21/2002	spring	W. Mackey Lake	532	F	6	post	empty
05/21/2002	spring	W. Mackey Lake	501	M	7	spawning	insects
05/21/2002	spring	W. Mackey Lake	327	M	3	spawning	empty
05/21/2002	spring	W. Mackey Lake	183	F	2	juvenile	insects
05/21/2002	spring	W. Mackey Lake	370	M	4	spawning	leeches, insects
05/21/2002	spring	W. Mackey Lake	318	M	3	spawning	leeches, insects
05/21/2002	spring	W. Mackey Lake	358	F	3	post	insects, fish
05/21/2002	spring	W. Mackey Lake	422	M	5	spawning	leeches, insects
05/21/2002	spring	W. Mackey Lake	512	F	6	post	leeches, insects
05/21/2002	spring	W. Mackey Lake	273	F	3	juvenile	insects
05/21/2002	spring	W. Mackey Lake	348	M	4	spawning	insects
05/21/2002	spring	W. Mackey Lake	245	M	2	spawning	insects
05/21/2002	spring	W. Mackey Lake	380	F	5	post	empty
05/24/2002	spring	Tree Lake	727	M	7	spawning	empty
05/24/2002	spring	Tree Lake	794	M	7	spawning	empty
05/24/2002	spring	Tree Lake	821	M	6	spawning	sticklebacks
05/24/2002	spring	Tree Lake	780	M	7	spawning	sticklebacks, ss(juv), insects
05/29/2002	spring	Denise Lake	770	F	7	post	empty
05/29/2002	spring	Denise Lake	605	M	8	spawning	insects, sticklebacks
05/30/2002	spring	Union Lake	442	M	3	spawning	leeches, clams
05/30/2002	spring	Union Lake	538	F	6	post	leeches, insects
05/30/2002	spring	Union Lake	426	F	4	post	insects
05/30/2002	spring	Union Lake	346	F	2	juvenile	leeches
05/30/2002	spring	Union Lake	597	M	6	spawning	leeches
05/30/2002	spring	Union Lake	483	M	5	spawning	leeches
05/30/2002	spring	Union Lake	400	M	3	spawning	leeches
05/30/2002	spring	Union Lake	341	F	2	juvenile	leeches
05/30/2002	spring	Union Lake	390	M	3	spawning	empty
05/30/2002	spring	Union Lake	540	F	R	post	empty
05/30/2002	spring	Union Lake	455	F	3	post	empty
05/30/2002	spring	Union Lake	349	F	2	post	insects
05/30/2002	spring	Union Lake	327	M	2	spawning	insects
05/30/2002	spring	Union Lake	521	F	5	post	insects
05/30/2002	spring	Union Lake	520	F	5	post	empty
05/30/2002	spring	Union Lake	411	F	3	post	empty
05/30/2002	spring	Union Lake	523	M	7	spawning	leeches, insects
05/30/2002	spring	Union Lake	505	M	5	spawning	insects
05/30/2002	spring	Union Lake	422	M	R	spawning	empty
05/30/2002	spring	Union Lake	368	M	3	spawning	insects
05/30/2002	spring	Union Lake	460	M	4	spawning	leeches
05/30/2002	spring	Union Lake	406	M	R	spawning	leeches

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Appendix B1.–Part 6 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
05/30/2002	spring	Union Lake	451	F	5	post	insects
05/30/2002	spring	Union Lake	260	F	1	juvenile	empty
05/30/2002	spring	Union Lake	533	M	5	spawning	leeches, insects
05/30/2002	spring	Union Lake	525	M	R	spawning	leeches, insects
05/30/2002	spring	Union Lake	375	M	2	spawning	insects
05/30/2002	spring	Union Lake	240	M	1	juvenile	empty
05/30/2002	spring	Union Lake	445	M	4	spawning	empty
05/30/2002	spring	Union Lake	443	M	3	spawning	empty
05/30/2002	spring	Union Lake	311	M	2	spawning	insects
05/30/2002	spring	Union Lake	246	M	2	juvenile	empty
05/30/2002	spring	Union Lake	396	M	3	spawning	empty
05/30/2002	spring	Union Lake	431	F	4	post	leeches
05/30/2002	spring	Union Lake	330	F	R	post	leeches
05/30/2002	spring	Union Lake	222	?	2	?	empty
05/30/2002	spring	Union Lake	492	M	6	spawning	empty
05/30/2002	spring	Union Lake	430	F	4	post	leeches, insects
05/30/2002	spring	Union Lake	332	F	R	post	leeches
05/30/2002	spring	Union Lake	207	?	1	?	empty
06/12/2002	spring	Derk's Lake	483	F	5	post	leeches, insects, snails
06/12/2002	spring	Derk's Lake	326	M	3	post	insects
06/12/2002	spring	Derk's Lake	490	F	6	post	insects
06/12/2002	spring	Derk's Lake	312	M	3	post	insects
06/12/2002	spring	Derk's Lake	480	F	5	post	insects
06/12/2002	spring	Derk's Lake	314	F	2	?	insects, clams
06/12/2002	spring	Derk's Lake	826	F	R	post	empty
06/12/2002	spring	Derk's Lake	374	F	4	post	empty
06/12/2002	spring	Derk's Lake	410	M	4	post	empty
06/12/2002	spring	Derk's Lake	373	M	4	post	insects
06/12/2002	spring	Derk's Lake	361	M	4	post	insects, clams
06/12/2002	spring	Derk's Lake	342	M	3	post	insects
06/12/2002	spring	Derk's Lake	445	M	5	post	insects
06/12/2002	spring	Derk's Lake	383	M	5	post	empty
06/12/2002	spring	Derk's Lake	516	M	5	post	insects
06/12/2002	spring	Derk's Lake	360	M	4	post	insects
10/03/2002	fall	Derk's Lake	592	M	R	adult	insects
10/03/2002	fall	Derk's Lake	449	M	6	adult	insects
10/03/2002	fall	Derk's Lake	282	M	1	adult	leeches, insects
10/03/2002	fall	Derk's Lake	145	?	0	juvenile	empty
10/03/2002	fall	Derk's Lake	450	F	4	adult	empty
10/03/2002	fall	Derk's Lake	435	M	5	adult	insects
10/03/2002	fall	Derk's Lake	128	?	0	juvenile	empty
10/03/2002	fall	Derk's Lake	472	F	6	adult	empty
10/03/2002	fall	Derk's Lake	414	M	4	adult	pike
10/03/2002	fall	Derk's Lake	443	M	5	adult	insects
10/03/2002	fall	Derk's Lake	408	M	7	adult	insects

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Appendix B1.–Part 7 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
10/03/2002	fall	Derk's Lake	425	M	5	adult	empty
10/03/2002	fall	Derk's Lake	418	F	4	adult	clams
10/03/2002	fall	Derk's Lake	415	M	5	adult	insects, clams
10/03/2002	fall	Derk's Lake	395	M	4	adult	insects
10/03/2002	fall	Derk's Lake	443	F	4	adult	empty
10/03/2002	fall	Derk's Lake	425	M	4	adult	insects
10/03/2002	fall	Derk's Lake	482	M	6	adult	insects
10/03/2002	fall	Derk's Lake	479	F	5	adult	insects
10/03/2002	fall	Derk's Lake	430	F	4	adult	empty
10/03/2002	fall	Derk's Lake	379	F	4	adult	insects
10/03/2002	fall	Derk's Lake	460	M	6	adult	empty
10/03/2002	fall	Derk's Lake	375	M	4	adult	insects
10/04/2002	fall	Sevena Lake	778	F	10	adult	fish
10/04/2002	fall	Sevena Lake	685	F	9	adult	fish
10/04/2002	fall	Sevena Lake	634	M	6	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	556	M	4	adult	fish
10/04/2002	fall	Sevena Lake	428	M	3	adult	1 Dolly Varden, fish
10/04/2002	fall	Sevena Lake	732	F	10	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	570	M	3	adult	insects
10/04/2002	fall	Sevena Lake	561	F	3	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	419	M	3	adult	empty
10/04/2002	fall	Sevena Lake	406	M	3	adult	sticklebacks
10/04/2002	fall	Sevena Lake	653	F	5	adult	3 Dolly Varden, northern pike
10/04/2002	fall	Sevena Lake	551	F	4	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	540	M	6	adult	empty
10/04/2002	fall	Sevena Lake	525	M	4	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	414	M	2	adult	empty
10/04/2002	fall	Sevena Lake	562	F	5	juvenile	1 Dolly Varden
10/04/2002	fall	Sevena Lake	718	F	9	adult	leeches, sticklebacks
10/04/2002	fall	Sevena Lake	715	F	7	adult	sticklebacks
10/04/2002	fall	Sevena Lake	652	F	5	adult	3 Dolly Varden
10/04/2002	fall	Sevena Lake	551	F	5	adult	insects, sticklebacks
10/04/2002	fall	Sevena Lake	440	F	4	juvenile	empty
10/04/2002	fall	Sevena Lake	699	F	7	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	695	F	5	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	464	F	3	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	648	F	6	adult	3 fish
10/04/2002	fall	Sevena Lake	587	M	6	adult	2 Dolly Varden, 1 SS
10/04/2002	fall	Sevena Lake	542	F	4	adult	fish
10/04/2002	fall	Sevena Lake	534	M	5	adult	empty
10/04/2002	fall	Sevena Lake	425	F	3	juvenile	empty
10/04/2002	fall	Sevena Lake	690	M	8	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	676	M	8	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	553	F	4	adult	fish
10/04/2002	fall	Sevena Lake	733	F	10	adult	3 Dolly Varden

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Appendix B1.–Part 8 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
10/04/2002	fall	Sevena Lake	667	F	8	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	562	M	6	adult	2 Dolly Varden
10/04/2002	fall	Sevena Lake	544	M	5	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	434	F	3	juvenile	empty
10/04/2002	fall	Sevena Lake	657	F	8	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	570	M	6	adult	fish
10/04/2002	fall	Sevena Lake	519	M	4	adult	empty
10/04/2002	fall	Sevena Lake	429	F	4	juvenile	empty
10/04/2002	fall	Sevena Lake	202	?	0	juvenile	empty
10/04/2002	fall	Sevena Lake	576	F	5	adult	1 Dolly Varden
10/04/2002	fall	Sevena Lake	563	F	4	adult	3 Dolly Varden
10/08/2002	fall	W. Mackey Lake	695	M	9	adult	empty
10/08/2002	fall	W. Mackey Lake	305	M	1	adult	detritus
10/08/2002	fall	W. Mackey Lake	305	M	1	adult	empty
10/08/2002	fall	W. Mackey Lake	205	U	0	juvenile	detritus
10/08/2002	fall	W. Mackey Lake	170	U	0	juvenile	worms
10/08/2002	fall	W. Mackey Lake	265	M	2	adult	insects
10/08/2002	fall	W. Mackey Lake	180	U	0	juvenile	insects
10/08/2002	fall	W. Mackey Lake	440	M	4	adult	detritus
10/08/2002	fall	W. Mackey Lake	420	M	2	adult	empty
10/08/2002	fall	W. Mackey Lake	535	M	7	adult	empty
10/08/2002	fall	W. Mackey Lake	435	M	5	adult	insects
10/08/2002	fall	W. Mackey Lake	330	M	2	adult	insects
10/08/2002	fall	W. Mackey Lake	455	M	4	adult	insects
10/08/2002	fall	W. Mackey Lake	400	F	4	adult	insects
10/08/2002	fall	W. Mackey Lake	335	M	2	adult	insects
10/08/2002	fall	W. Mackey Lake	185	M	1	juvenile	detritus
10/08/2002	fall	W. Mackey Lake	500	M	6	adult	insects
10/08/2002	fall	W. Mackey Lake	375	M	5	adult	insects
10/08/2002	fall	W. Mackey Lake	565	M	R	adult	empty
10/08/2002	fall	W. Mackey Lake	405	M	3	adult	insects
10/08/2002	fall	W. Mackey Lake	400	M	R	adult	insects
10/08/2002	fall	W. Mackey Lake	565	F	6	adult	halibut
10/08/2002	fall	W. Mackey Lake	460	F	6	adult	empty
10/08/2002	fall	W. Mackey Lake	440	F	4	adult	insects
10/08/2002	fall	W. Mackey Lake	485	F	4	adult	empty
10/08/2002	fall	W. Mackey Lake	435	M	R	adult	insects
10/08/2002	fall	W. Mackey Lake	495	F	4	adult	empty
10/08/2002	fall	W. Mackey Lake	485	M	4	adult	detritus
10/09/2002	fall	E. Mackey Lake	625	F	9	adult	empty
10/09/2002	fall	E. Mackey Lake	405	F	3	adult	empty
10/09/2002	fall	E. Mackey Lake	485	F	5	adult	detritus
10/09/2002	fall	E. Mackey Lake	375	F	3	adult	empty
10/09/2002	fall	E. Mackey Lake	450	M	5	adult	insects
10/09/2002	fall	E. Mackey Lake	415	M	4	adult	pike

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Appendix B1.–Part 9 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
10/09/2002	fall	E. Mackey Lake	475	F	6	adult	empty
10/09/2002	fall	E. Mackey Lake	405	F	4	adult	detritus
10/09/2002	fall	E. Mackey Lake	670	F	9	adult	empty
10/09/2002	fall	E. Mackey Lake	295	M	2	adult	empty
10/09/2002	fall	E. Mackey Lake	675	M	10	adult	empty
10/09/2002	fall	E. Mackey Lake	350	F	4	adult	empty
10/09/2002	fall	E. Mackey Lake	575	F	7	adult	insects
10/09/2002	fall	E. Mackey Lake	335	F	3	adult	detritus
10/09/2002	fall	E. Mackey Lake	355	M	3	adult	empty
10/09/2002	fall	E. Mackey Lake	310	F	2	adult	detritus
10/09/2002	fall	E. Mackey Lake	160	U	0	juvenile	detritus
10/09/2002	fall	E. Mackey Lake	375	M	3	adult	empty
10/09/2002	fall	E. Mackey Lake	410	M	3	adult	detritus
10/09/2002	fall	Tree Lake	810	M	12	adult	1 coho salmon (juv)
10/09/2002	fall	Tree Lake	790	M	10	adult	empty
10/10/2002	fall	Union Lake	165	U	0	juvenile	leeches
10/10/2002	fall	Union Lake	520	F	6	adult	insects
10/10/2002	fall	Union Lake	495	F	5	adult	insects
10/10/2002	fall	Union Lake	480	F	5	adult	insects
10/10/2002	fall	Union Lake	180	U	0	juvenile	detritus
10/10/2002	fall	Union Lake	540	M	6	adult	detritus
10/10/2002	fall	Union Lake	495	F	5	adult	insects
10/10/2002	fall	Union Lake	420	F	5	adult	leeches
10/10/2002	fall	Union Lake	355	U	R	juvenile	insects
10/10/2002	fall	Union Lake	535	F	6	adult	insects
10/10/2002	fall	Union Lake	495	M	5	adult	insects
10/10/2002	fall	Union Lake	375	M	3	adult	insects
10/10/2002	fall	Union Lake	295	U	1	juvenile	insects
10/10/2002	fall	Union Lake	575	F	6	adult	insects
10/10/2002	fall	Union Lake	480	M	6	adult	insects
10/10/2002	fall	Union Lake	350	M	2	adult	empty
10/10/2002	fall	Union Lake	585	M	6	adult	insects
10/10/2002	fall	Union Lake	470	M	5	adult	leeches, insects
10/10/2002	fall	Union Lake	405	M	R	adult	leeches, insects
10/10/2002	fall	Union Lake	330	M	2	adult	insects
10/10/2002	fall	Union Lake	165	U	0	juvenile	detritus
10/10/2002	fall	Union Lake	495	F	4	adult	insects
10/10/2002	fall	Union Lake	440	M	4	adult	insects
10/10/2002	fall	Union Lake	430	F	4	adult	leeches
10/10/2002	fall	Union Lake	560	M	5	adult	insects
10/10/2002	fall	Union Lake	450	M	3	adult	insects
10/10/2002	fall	Union Lake	435	M	4	adult	empty
10/10/2002	fall	Union Lake	600	M	5	adult	insects
10/10/2002	fall	Union Lake	475	F	3	adult	empty
10/10/2002	fall	Union Lake	475	F	R	adult	insects

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Appendix B1.–Part 10 of 10.

Sampling date (mm/dd/yyyy)	Season[a]	Location	Fork length (mm)	Sex[b]	Age[c]	Maturity	Stomach contents[d]
10/10/2002	fall	Union Lake	635	F	8	adult	northern pike
10/10/2002	fall	Union Lake	495	M	4	adult	insects
10/10/2002	fall	Union Lake	485	M	5	adult	insects
10/10/2002	fall	Union Lake	590	M	7	adult	insects
10/10/2002	fall	Union Lake	565	F	6	adult	insects
10/10/2002	fall	Union Lake	315	M	2	adult	detritus
10/11/2002	fall	Denise Lake	500	M	4	adult	sticklebacks

Note: "?" = unknown.

[a] Seasons: "spring" = 9 May–12 June; "fall" = 3–11 October.

[b] Sex: "M" = male, "F" = female.

[c] Age as determined by scale reading. "M" = missing scale; "R" = regenerated scale (unreadable).

[d] Stomach contents: "SS" = coho salmon (juv) for entries with limited space; "stickleback" = threespine stickleback.